OUT OF THEIR MINDS AND ONTO THE PAGE: THE PRODUCTION AND USE OF NURSES' PAPER "BRAINS" IN A MEDICAL ONCOLOGY UNIT

by

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ABSTRACT

Standardizing handoffs is recommended to improve communication, with electronic tools as the primary approach. However, nurses continue to rely on paper tools they call "brains." Therefore, the purpose of this dissertation is to develop a deep understanding of nurses brains in the context of a medical oncology unit.

A grounded theory approach was used to explore nurses paper brains. Seventy-three hours of field observations in a medical oncology unit led to 13 purposively sampled nurses who were shadowed for a single shift and interviewed. The data corpus included images of paper brains, transcribed interviews, field notes, and analytic memos. Consistent with grounded theory techniques, the data were coded and collected into categories of similar ideas. Concepts emerged from further analysis and interpretation of codes and categories.

Results were indicative of four major aspects of nurses' paper brains. Brains provide cognitive support through broad structure and synthesized content, are a representation of nurses' personal and professional identity, are a tangible representation of nurses' patients and hold "the story of the patient," and are living objects that traverse a life cycle during each shift and evolve during the course of a nurse's career. Because brains are indeed cognitive artifacts, any electronic design will need at minimum six traits: accuracy, efficiency, reliability, informativeness, clarity, and malleability. However, given that nurses' paper brains extend beyond purely cognitive support and embody a living nature, the development of a successful electronic brain is unlikely given the current state of technology.

Paper brains support nurses' work beyond simply cognition. Standardized designs that ignore the full purpose of paper brains are doomed to fail. Changes to handoff tools without nurse input may be seen as personal attacks and decrease morale. Administration should be mindful of potential unintended consequences of changes to clinical practice, as standardized brain design may need to be updated to continue being effective. The importance of paper brains in nursing practice should be reflected in nursing education via didactic training in their development and use. Future research is recommended to assess generalizability outside a medical oncology unit and for different patient trajectories.

For Solomon.

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CHAPTER 1

INTRODUCTION

Nurses are well known to produce their own personalized objects to organize information during a shift (Hardey, Payne, & Coleman, 2000; Klee, Latta, Davis-Kirsch, & Pecchia, 2012; Randell, Wilson, Woodward, & Galliers, 2011; Randell, Woodward, Wilson, & Galliers, 2008; Staggers, Clark, Blaz, & Kapsandoy, 2012, 2011). Previous research has characterized these objects as "handoff tools" (Alvarado et al., 2006; Athwal, Fields, & Wagnell, 2009; Baldwin & McGinnis, 1994; Caruso, 2007; Davies & Priestly, 2006; Mosher & Bontomasi, 1996; Welsh, Flanagan, & Ebright, 2010; M. Wilson, 2007). However, this characterization may be a limited view of the purposes these objects serve and the processes that lead to their construction. The term also assumes that these are purely functional objects, produced for the specific task of the intershift handoff, yet the collection or organization of patient information for handoffs accounts for only a portion of their use. Interestingly, nurses themselves do not refer to these objects as "handoff tools." Nurses have been known to call them "scraps" (Hardey et al., 2000), "my paper" (Hardey et al., 2000; Staggers et al., 2012, 2011), and "brains" (Staggers et al., 2012, 2011). The latter term indicates a deeper purpose for these objects than just handoffs, thus the term "brains" will be used to represent these objects in this dissertation.

Previous research has described brains as private spaces that combine personal and professional knowledge. Brains are an informal documentation outside of the official health-care record and have only recently been recognized as an integral part of nursing workflow (Hardey et al., 2000; McLane, Esquivel, & Turley, 2009; Randell et al., 2008; Staggers et al., 2012, 2011). Nurses have reported using their brains to synthesize information about patients and plan care for the upcoming shift (Hardey et al., 2000; Staggers et al., 2012, 2011). Yet brains are more than just a place to store information and prioritize tasks. Hardey et al. (2000) claim that nurses' brains exist as a space to define and organize nursing knowledge. Because brains are designed as a personal and private space, they are a safe place to record information and reminders that might be inappropriate to include

in the official medical record (Randell et al., 2008; Staggers et al., 2012, 2011). Though these studies were limited to the context of handoff, results hint at uses beyond this context that influence how nursing is practiced. Even so, research has yet to move in this direction. There is no research to date that describes the meaning brains have for nurses, the process of their construction, and the role brains play during an entire shift.

Standardizing free-form handoff tools has been suggested as a strategy to improve efficiency of giving report at the end of a shift (American Health Consultants, Inc., 2005). This has led to a focus on the content and computerization of handoff tools in the research literature, and thus a technical and functional focus on nurses' brains as cognitive artifacts (Collins, Stein, Vawdrey, Stetson, & Bakken, 2011; McLane et al., 2009, 2010; Randell, Wilson, Woodward, & Galliers, 2010). However, in a recent study, researchers observed that nurses will continue to use personally created brains, even when an electronic handoff tool, designed with nurse input, and linked to the electronic healthcare record (EHR) was available (Staggers et al., 2012, 2011). Research has also demonstrated that nurses use their brains throughout an entire shift as a quick reference for information pertinent to a shift, a to do list, and a place to synthesize data into a holistic representation of a patient (Hardey et al., 2000; Klee et al., 2012; McLane et al., 2010; Randell et al., 2008; Staggers et al., 2012, 2011). It is possible that standardized handoff tools have not been more widely adopted because nurses' brains and their functions are not fully understood. Standardized tools designed to incorporate the range of purposes have greater potential to be adopted that those that do not. Therefore, an understanding of the production and meaning of brains for nurses is imperative because a standardized tool must support all needs of its users or it is doomed to be underutilized (Nielsen, 1993; Shneiderman & Plaisant, 2010).

The purpose of this dissertation research is to develop a deep understanding of nurses' brains in the context of a medical oncology unit at a cancer hospital that is part of an academic health sciences center. A grounded theory approach will allow for the development of this understanding, including the meanings ascribed to brains, how nurses produce their brains, and a deep knowledge of the functions brains serve for nurses in a medical oncology setting. Further, strategies for the development of successful electronic tools will be derived from the ideas developed. This study will be limited to a single unit to allow a deep understanding of brains, without having to tease out cultural differences across units. The medical oncology unit was selected because the researcher has prior experience conducting research in this setting and nurses working in the unit have demonstrated interest in participating in further research studies with the researcher. In addition, patients admitted

to the medical oncology unit tend to be complex, with comorbidities beyond treatment for cancer. This complexity creates a setting rich with data, ideal for grounded theory techniques.

1.1 Specific Aims

The specific aims for this study are the following:

Aim 1. To use a grounded theory approach to develop a deep understanding of nurses brains, including the meanings ascribed to brains, how nurses produce their brains, the functions brains serve for nurses practicing in a medical oncology setting, and the content and structure found in brains.

Aim 2. To derive successful strategies for the development of an electronic brain that can be used as a handoff tool.

The remainder of this dissertation will be addressed in four chapters. Chapter 2 presents a review of the literature previously published on nursing handoff, handoff tools, nursing private documentation (brains), nurses' brains as cognitive artifacts, and standardized handoff tools. Chapter 3 presents symbolic interactionism as the theoretical framework underlying the study, grounded theory as the methodology, and a description of the specific methods used to conduct the study. Chapter 4 presents the findings, and Chapter 5 provides a discussion of the results, including study contributions, limitations, and areas for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 Handoffs

In the United States and elsewhere, nursing handoffs, also called handover, change of shift report, intershift report, and sign-out, occur during every shift change, every day of the year in every acute care unit nationwide. Due to the frequency of nursing handoffs, great potential for harm may be caused by information loss or misinterpretation during the activity. Breaches in patient safety have been linked to failures in communication, including sentinel events (Croteau, 2005), critical incidences (Pezzolesi et al., 2010), and errors and near misses in novice nurses (Ebright, Urden, Patterson, & Chalko, 2004). In 2006, the Joint Commission, then known as the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), made improving handoff communication one of their patient safety goals, with the suggestion that handoffs follow a standard format (American Health Consultants, Inc., 2005). Since then, research about nursing handoffs has increased (Riesenberg, Leitzsch, & Cunningham, 2010).

2.1.1 Definition of Handoffs

No single definition of nursing handoffs exists in the research literature. Early definitions focus on the handoff as a communication event that occurs between two shifts of nurses—nurses ending their tour of duty providing information about care given during their shift to the nurses beginning their tour of duty (Clair & Trussel, 1969). Even as late as 2000, definitions focused on the communication aspect of handoffs. Lamond (2000) defined the handoff as "a communication which occurs between two shifts of nurses, where the purpose is thought specifically to be communicating information about patients under the nurses' care" (p. 794). The idea of transferring responsibility for patient care during handoff implicit in Lamond's definition is made explicit in the most recent definitions. Cohen and Hilligoss (2010) define handoff as "the exchange between health professionals of information about a patient accompanying either a transfer of control over, or of responsibility for, the

patient" (p. 494). This definition emphasizes the communication aspect while adding a nod to the transfer of responsibility for patient care. In contrast, Abraham, Kannampallil, and Patel's (2012) definition emphasizes the latter: "Handoffs in healthcare refer to the transfer of care from one clinician to the next and involve a transfer of information, responsibility, and authority for patient care" (p. 240). For this study, the Abraham et al. definition will be used. Handoffs have no reason to occur unless there is a transfer of patient care, and though the communication of information is a major aspect of handoffs, it is not the only purpose they serve.

2.1.2 Purposes of Handoff

The primary purpose of nursing handoff is the transfer of information. The information exchanged during handoff assists nurses in making appropriate clinical decisions and prioritizing patient care for the upcoming shift (Matic, Davidson, & Salamonson, 2011; Strople & Ottani, 2006), and allows nurses to establish a mutual understanding of patients' conditions (Collins et al., 2012; Groah, 2006). During a handoff, nurses expect to receive contextual information such as patient demographics, reason for admission, and the name and contact information for the treating physician or team. Information regarding the plan of care including physician orders, major care events that have occurred during the last shift and planned during the upcoming shift, and clinical events that have happened during a patient's stay are also included. The majority of information given during handoffs consists of an overview of current patient status including a summary of the patient's clinical status at the moment and progression during the last shift (Johnson, Jefferies, & Nicholls, 2012; Mayor, Bangerter, & Aribot, 2012; Staggers et al., 2012). Safety information such as code status and known allergies are also expected during handoff (Collins et al., 2011; Staggers et al., 2012).

Though the exchange of patient information is considered the primary purpose of nursing handoffs, other purposes exist. Handoffs allow for the socialization of nurses into the specific culture where they work, generating a feeling of solidarity and a place where their work is valued (Lally, 1999; Parker, Gardner, & Wiltshire, 1992; Z. Wolf, 1988; Yonge, 2008). Students and new nurses learn about nursing diagnoses, treatments, and care plans during handoffs, and have an opportunity for professional role development (Ekman & Segesten, 1995; M. Kerr, 2002; Skaalvik, Normann, & Henriksen, 2010; Strange, 1996). During handoffs, nurses develop as a cohesive team and become aware of the unit-specific abbreviations, jargon, and other social knowledge specific to the profession required of the fast-paced, often cryptic nature of report (Payne, Hardey, & Coleman, 2000; Strople &

Ottani, 2006). Handoff also provides a safe arena for emotional support where nurses can safely unburden and regroup, and reduce stress, anxiety, and burn-out (Hopkinson, 2002; Lally, 1999; Parker et al., 1992; Z. Wolf, 1988; Yonge, 2008). Recently, focus has turned to handoffs as a form of resilience, protecting against clinical errors. Patterson and Wears (2010) identified handoffs as a way to detect erroneous assumptions, actions, and errors, and thus prevent future patient harm.

2.1.3 Handoff as a Ritual

In several studies, nursing handoff has been described as a ritual (Ekman & Segesten, 1995; Evans, Pereira, & Parker, 2008; Holland, 1993; Strange, 1996; Z. Wolf, 1988; Z. R. Wolf, 1993). According to DeCraemer, Vansina, and Fox (1976), ritual consists of patterned and symbolic action that refers to goals and values held by a social group. Nursing handoffs fall under this definition of ritual in that they are patterned and symbolic. Handoff frequently occurs in the same physical space, using a similar verbal structure (i.e., patients are reported in numerical order of bed or room number), and demonstrating a hierarchy among nurses of different expertise (Ekman & Segesten, 1995; Holland, 1993; Strange, 1996; Z. Wolf, 1988). Symbols such as uniforms, exchange of keys to indicate passing of responsibility, and professional jargon are also apparent in nursing handoff (Holland, 1993; Strange, 1996; Z. Wolf, 1988). Nursing handoffs, as rituals, serve to bring coherence to the nursing unit by demonstrating unwritten rules and values held by the profession, and aiding the creation of an ideology for the cultural group of nurses (Ekman & Segesten, 1995; Evans et al., 2008; Holland, 1993; Strange, 1996; Z. Wolf, 1988; Z. R. Wolf, 1993).

2.1.4 Format of Handoff

Handoffs are typically informal and unstructured, often occurring in a noisy environment subject to interruptions (McCloughen, O'Brien, Gillies, & McSherry, 2008; Staggers & Jennings, 2009). Three locations for nursing handoff are generally mentioned in the literature: in a room away from the nursing station such as a conference room, in or near the nursing station, or in or near the patient's room (Riesenberg et al., 2010; Sexton et al., 2004; Staggers & Jennings, 2009; Strange, 1996). Handoffs in or near a patient's room are assumed to be quieter than in other locations, but handoffs in all locations experience interruptions. Sources of interruptions include questions from other clinical providers, questions or requests from patients, and telephone calls to the unit (Staggers & Jennings, 2009).

Methods of handoffs vary. At least five methods of handoffs exist: verbal, taped, silent or written, bedside, or computerized; in some cases, methods occur in combination such

as a verbal report supported by a computer application (Chaboyer, McMurray, & Wallis, 2010; Johnson et al., 2012; D. Kerr, Lu, McKinlay, & Fuller, 2011; Klee et al., 2012; Laws & Amato, 2010; Matic et al., 2011; Miller, 1998; Riesenberg et al., 2010; Strople & Ottani, 2006). A move toward bedside handoff is apparent in the literature (Benestante & Mitcham, 2008; Bolanos, 2008; Caruso, 2007; Chaboyer et al., 2010; Laws & Amato, 2010; Maltman, DiRico, & Monachino, 2007; Miller, 1998; Watkins, 1993). Communication at the patient's bedside allows for contributions from the patient and patient's family members. Although this input has the potential to reduce errors (Hale, 2009), bedside handoffs can limit nurses' ability to discuss sensitive information in the presence of the patient and family members (Sexton et al., 2004). To date, no single handoff method has been shown to be best in terms of efficiency and effectiveness (McKenna & Walsh, 1997; Riesenberg et al., 2010). O'Connell and Penney (2001) speculate that this is due to differences in contexts, patients, and nurses that cannot be addressed by any single handoff format.

Verbal handoff accompanied by a printed or written tool is described frequently in the literature (Hardey et al., 2000; Klee et al., 2012; Parker et al., 1992; Philpin, 2006; Randell et al., 2011; Staggers et al., 2012, 2011; Staggers & Jennings, 2009). In a study simulating a handoff setting, Pothier, Monteiro, Mooktiar, and Shaw (2005) demonstrated that nurses were able to retain more data over recurring communications when verbal handoff was supported with a paper-based patient summary when compared to verbal handoff alone. Further, nurses retained the most data with a preprinted patient summary compared to a hand-written summary. However, nurses in a recent study described the ability to take notes during handoff was critical, allowing information to be tailored to individual needs (Staggers et al., 2011). Printed or written tools thus appear to play an important role in nursing handoffs.

2.1.5 Informal Handoff Documentation ("Brains")

In an ethnographic study, Hardey et al. (2000) described tools individual nurses created and used in England in the late 1990s. These authors characterized the paper tools as "scraps" because they consisted of a piece of paper or notebook where nurses recorded information given during a handoff. Nurses in the study called these objects "my paper" or "my scrappy piece of paper," in addition to the word "scraps." On these scraps, a combination of information existed about patients (e.g., name, diagnosis, medications, etc.) and a "to do" list of tasks to complete during the shift. The authors did not mention whether any standardized format existed; implying that scraps were "designed only to be understood and used by their owner" (p. 211). Though this study was completed before

the ubiquity of EHRs, the findings of more current studies are in agreement. All 26 nurses in a recent study relied on paper forms, often referred to by the participants as "brains," to give verbal handoff, even though an electronic nursing summary report existed in the EHR (Staggers et al., 2012, 2011). This nursing summary report was sometimes printed prior to receiving handoff for use as a brain, but was always modified during handoff with additional notes and/or "to do" lists. In fact, Staggers et al. (2011) observed that the EHR was used during handoffs only to double check observations such as the most recent vital signs or whether a physician's order had been updated. Randell et al. (2011) reported a similar practice across five UK hospitals. There, nurses would print out an electronic handover sheet generated in Microsoft®Word. The document contained a table summarizing all patients in the unit. Nurses would annotate these sheets during handoff and refer to them as necessary during a shift. The electronic document was generally updated once per shift by the nurse in charge of the unit for that shift.

Nurses' brains have historically been developed by individual nurses, organizing and tailoring information into a format specifically designed only for the individual (Hardey et al., 2000; Klee et al., 2012; Staggers et al., 2012, 2011). Nurses acknowledge this individuality claiming, "This makes sense to me...I think we're all unique and we all need different things" (Staggers et al., 2012). Brains provide a private space to synthesize information, organize tasks and prioritize work, and record information inappropriate for the official medical record (e.g., patient preferences such as "likes apple juice") (Hardey et al., 2000; Randell et al., 2008; Staggers et al., 2012).

2.1.5.1 Nurses' Brains as Cognitive Artifacts

Nurses' brains have been described as "cognitive artifacts" (Collins et al., 2011; McLane et al., 2009, 2010; Randell et al., 2010; Staggers et al., 2011; S. Wilson, Galliers, & Fone, 2007). Cognitive artifacts play an essential role in cognition in complex systems. Norman (1991) defines a cognitive artifact as "an artificial device designed to maintain, display or operate upon information in order to serve a representational function" (p. 17) Thus, a cognitive artifact is essentially a tool that provides cognitive support by offloading a portion of the cognitive work required to do a task from the human mind to an external object. Nurses' brains indeed provide this function (Collins et al., 2011; McLane et al., 2010; Staggers et al., 2011; S. Wilson et al., 2007). Attributes of cognitive artifacts include relevancy in context, reduction of memory load for the user, support of rapid data synthesis for recognition and inference, augmentation of knowledge and internal representations, support of cognition without conscious effort by the user, promotion of efficient and effective

user actions, limitation of abstraction, ability to make latent data concrete, facilitation of critical thinking, and maximization of accuracy and minimization of user effort in decision making (McLane et al., 2010; Zhang & Patel, 2006). All of these functions have been indicated for nurses' brains (Collins et al., 2011; Hardey et al., 2000; Randell et al., 2008, 2010, 2011; Staggers et al., 2012, 2011; S. Wilson et al., 2007). As cognitive artifacts, nurses' brains have recently been the focus of attempts to standardize handoff through computerization. Brains are a symbol of "being a good nurse" and unless attempts at computerizing or standardizing brains address this cultural function as well as the cognitive functions, they are doomed to fail (Staggers et al., 2012).

2.2 Standardized Handoff Tools

Though standardization has been suggested as one possible solution to creating a more structured and effective report, a lack of accepted guidelines for handoffs and no consensus for the best possible format exist (Dracup & Morris, 2008; Riesenberg et al., 2010; Sexton et al., 2004; Strople & Ottani, 2006; S. Wilson et al., 2007). In a study simulating a handoff setting, Pothier et al. (2005) showed nurses were able to retain more data over recurring communications when verbal handoff was supported with a paper-based patient summary than verbal handoff alone. Further, nurses retained the most data with a preprinted patient summary compared to a hand-written summary. The increased availability of electronic healthcare records (EHRs) affords a natural platform for standardized handoff tools, but a scarcity of research describing such tools exists. Thus, an integrative review to identify and describe handoff tools designed for nursing handoffs in acute care settings was completed.

2.2.1 Integrative Review Methods

The author completed a systematic literature search for nursing handoff tools using PubMed, CINAHL, PsychInfo, and Scopus databases. Search terms included (handover OR handoff OR shift report OR intershift report). Peer-reviewed publications with a focus on nursing handoffs in an acute care setting with a description of a handoff tool were included in the review. "Tool" was defined broadly as any memory aid or any standardization method used during handoff. The search was limited to articles published in English from 1990 through 4 March 2011. Letters, editorials, conference abstracts, and dissertations were excluded. The initial search yielded 625 citations. The author reviewed titles and abstracts of these citations for possible description of a handoff tool. Four hundred ninety-one citations clearly did not meet inclusion criteria. For the remaining 134 citations, the author retrieved and read the full articles. Fourteen articles met the full inclusion criteria

including having a description of a tool.

2.2.2 Integrative Review Results

The final set of 14 relevant studies is displayed in an evidence table (see Table 2.1). The table outlines each study's design, country of origin, type of hospital unit, handoff tool design, article focus, measures of impact if applicable, and major findings if impact was evaluated.

2.2.2.1 Type of Article

Twelve of the articles were quality improvement (QI) projects (Alvarado et al., 2006; Athwal et al., 2009; Baldwin & McGinnis, 1994; Caruso, 2007; Christie & Robinson, 2009; Clark, Squire, Heyme, Mickle, & Petrie, 2009; Davies & Priestly, 2006; Fenton, 2006; Mosher & Bontomasi, 1996; Nelson & Massey, 2010; Schroeder, 2006; M. Wilson, 2007) and two were qualitative research studies (Welsh et al., 2010; Yee, Wong, & Turner, 2009). Four of the 12 QI projects described the impact of the new handoff tool or process anecdotally, 3 had questionnaires asking about nurses' perceptions of a change in handoff process, and 5 included empirical measures of improvement such as reduction in average length of shift-to-shift report. Nurse and/or staff satisfaction increased in all cases where efforts standardizing handoffs were conducted.

2.2.2.2 Tool Format

The 14 articles included descriptions of four general types of handoff tools: 5 different printed templates, 3 printed spreadsheets, 4 mnemonics, and 2 checklists. Five articles described printed templates generated electronically but with little or no EHR integration (Athwal et al., 2009; Baldwin & McGinnis, 1994; Caruso, 2007; Davies & Priestly, 2006; M. Wilson, 2007). All five forms required information to be manually entered during the shift. The templates showed a consistent format with static information located at the top of the printed page, including patient demographic data, admitting diagnosis, admission date, and relevant patient history. The rest of the page was intended for other information such as care provided during the shift, information about intravenous access and drains, assessments, test orders and results, and medications. All but one template (Caruso, 2007) visually organized the information into blocks or tables. Two of the five templates included a section for comments or remarks separate from the other information in report (Baldwin & McGinnis, 1994; Davies & Priestly, 2006). Two forms included a "medication clock" separated into hours of the day (Athwal et al., 2009; M. Wilson, 2007), an area to record

times medications are due and administered.

The printed spreadsheets (Mosher & Bontomasi, 1996; Nelson & Massey, 2010; Welsh et al., 2010) were closely related to the printed templates. Mosher and Bontomasi (1996) described a spreadsheet that clinicians printed blank and updated manually throughout the shift; Nelson and Massey (2010) described an electronic spreadsheet generated and updated in its electronic format by the nurses throughout their shifts, then printed and handed to the next nurse during report. Welsh et al. (2010) did not make clear when in the shift their spreadsheet was printed, only noting it was given to the next nurse at the end of the shift. The three spreadsheets differed from the other printed templates because they provided less structure for recording information, lacking tables for recording lab values, or times when medications were due, for example. The columns in one of the three spreadsheets were visually grouped using categories from SBAR (Situation, Background, Assessment Recommendations) mnemonic, a unique feature (Nelson & Massey, 2010).

Alvarado et al. (2006) and Fenton (2006) presented handoff tools with a checklist design. The Alvarado et al. (2006) checklist provided a list of items for nurses to cover during handoff visually grouped into three sections: plan of care, patient status review, and bedside patient safety checklist. They also mentioned a "staff nurse written tool" (p. 78), but no description of that particular tool was given. One unique aspect of this checklist was the specific focus on bedside patient safety, including prompts to check patient armbands, IV solutions against the Medications Administration Report, allergies, alarms, and risk concerns.

The second checklist (Fenton, 2006) was a laminated list of information to cover during handoff designed specifically for elderly patients in a community rehabilitation hospital. Information included demographics, continence, pressure areas, safety, self-care, hygiene and oral care, privacy and dignity, communication, and nutrition/hydration. A corresponding printed form was available, but the printout was not mandatory.

Authors of four articles described three different mnemonics for structuring the handoff, including PACE (Schroeder, 2006), SBAR (Christie & Robinson, 2009; Clark et al., 2009), and HAND ME AN ISOBAR (Yee et al., 2009) (see Table 2.2). PACE established a standardized process with the following four categories: P: Patient/Problem, A: Assessment, C: Continuing/Changes, and E: Evaluation. Nurses were encouraged to use the structure to organize information throughout the shift (Schroeder, 2006). Christie and Robinson (2009) introduced SBAR as a structure for all types of handoff communication, including nursing handoff. Nurses were to use a formalized SBAR handoff sheet, but no description of these

sheets was provided. Clark et al. (2009) implemented SBAR for both nurse-to-nurse and nurse-to-physician communication. The SBAR mnemonic and its corresponding definitions were included in prompt cards clipped to nurses' identity badges, meant to encourage a standardized handoff format. HAND ME AN ISOBAR is a mnemonic covering four phases of handoff, as noted in Table 2.2 (Yee et al., 2009). This mnemonic is unique because its first three phases prepare nurses for the last phase when information is actually conveyed. In contrast, the other two mnemonics focused only on this last phase.

2.2.2.3 Tool Content

The content of each tool varied from general guides to more comprehensive instruments. Mnemonics, such as SBAR, provided only general prompts for conveying more complete information during report. All other tools included patient demographics, most often including patient name, diagnosis or presenting problem, and primary physician's name, code status, and allergies. Content varied in specificity for assessment, laboratory results, and intravenous lines. In general, the template described by Wilson was the most specific, providing each assessment area, each laboratory test name, and gauge, site, fluid, and rate for intravenous lines. An area for describing nursing assessments was absent from three tools (Baldwin & McGinnis, 1994; Davies & Priestly, 2006; Mosher & Bontomasi, 1996) and merely listed on two tools (Athwal et al., 2009; Fenton, 2006). One tool provided some specifics for assessment (Nelson & Massey, 2010), but was not as complete as Wilson's. Though the areas for assessment were included in two other tools (Alvarado et al., 2006; Caruso, 2007), this information was not grouped together and labeled as "assessment." Laboratory test results were listed on every tool except two (Davies & Priestly, 2006; Fenton, 2006). Six tools supplied areas labeled generally for labs (Alvarado et al., 2006; Baldwin & McGinnis, 1994; Caruso, 2007; Mosher & Bontomasi, 1996; Nelson & Massey, 2010; Welsh et al., 2010) and one tool had an area for abnormal lab values (Athwal et al., 2009). Intravenous lines were not mentioned on two tools (Fenton, 2006; Mosher & Bontomasi, 1996). Six tools provided areas labeled as "IV" or "IVF" only (Alvarado et al., 2006; Athwal et al., 2009; Baldwin & McGinnis, 1994; Davies & Priestly, 2006; Nelson & Massey, 2010; Welsh et al., 2010), while two other tools prompted for more specific information (Caruso, 2007; M. Wilson, 2007).

2.2.3 Integrative Review Discussion

The majority of authors developed handoff tools using quality improvement methods. Only two articles described research endeavors; both used qualitative techniques. No

research exploring handoff tools using experimental or quasi-experimental designs are yet available. Formats for all tools ranged from mnemonics to a very detailed and structured template, and information contained in handoff tools had differing levels of granularity.

Descriptions of tools from quality improvement projects provide valuable information about implementing a new handoff process in a clinical environment, but they do not provide systematic comparisons about the accuracy or efficiency of differing tools or processes. No authors provide rationale for tool format effectiveness and no standard measures are available for tool comparisons. Authors used self-developed questionnaires that lack psychometric assessments. The only two empirically measured variables in these studies were time and cost savings. No authors examined whether data in the tools or in report matched patient conditions. Athwal et al. (2009) reported a decrease in falls and a decrease in infections after a new handoff format was implemented; however, these findings are difficult to attribute to the change in format because the study did not measure possible confounding factors.

Improvements in handoffs for acute care cannot yet be attributed to a specific format, tool content or guide (mnemonic). In fact, every author claimed positive results with their particular implementation. This statement must be qualified in that descriptions of tools that do not improve handoff are typically not published. The lack of a "best" format may suggest that nurses greatly modify new tools to fit their specific needs in their particular settings. For example, in previous work nurses extensively modified printed, computerized handoff tools by adding notes and timetables to the tools (Staggers et al., 2012, 2011). Although not specifically reported, nurses in the studies included here may also modify the tools to their specific needs.

Consistent with the findings on formats, differing levels of content specificity seemingly did not affect nurses' perceptions about whether the introduced tool improved handoff. Publication bias and/or nurse modification as described previously may also explain the success of tools in improving handoff despite the variety in information content granularity. This notion calls into question the assumption that handoff information should be comprehensive for all aspects of the patient. If a handoff including only a short checklist is perceived by nurses to improve report, what subset of information from the patients medical record is truly necessary for an effective handoff?

2.2.4 Integrative Review Conclusions

Published handoff tools for nursing handoff exist in a variety of formats with differing levels of content specificity. Well-designed, empirical studies to compare different formats

in the same environment are needed to compare these formats. More fundamentally, if the format is not the distinguishing element, then what are the essentials for improving handoff? Studies to determine how handoff tools are used throughout the nursing shift are necessary to fully understand handoff tools. This understanding may illuminate the successful attributes of shift report tools.

Table 2.1: Research on Nursing Handoff Tools for Acute Care Units

Author and Year	Type of Study	Location	Type of Unit	Tool Design	Article Focus	Assessment of Impact	Results
Nelson and Massey, 2010	QI† Initiative	United States	Gastrointestinal surgical oncology unit	Spreadsheet	Description of QI initiative process with measures	Average length of report; average cost of overtime based on average length of report; nurses satisfaction with report process	Average length of report reduced from 66 minutes to 38 minutes;
Welsh et al., 2010	Qualitative, descriptive pilot study	United States	General internal medicine, acute care oncology, and surgical intensive care unit	Spreadsheet	Listing of barriers and facilitators for shift report	None	Recommendations for report process design

†Quality Improvement

††Methicillin-Resistant Staphylococcus aureus

†††Situation Background Assessment Recommendation

Table 2.1 continued

Author and Year	Type of Study	Location	Type of Unit	Tool Design	Article Focus	Assessment of Impact	Results
Yee et al., 2009	Qualitative, descriptive pilot study	Australia	General medicine, general surgery, emergency medicine	Mnemonic	Description of approach to development and validation of an overarching minimum dataset (MDS) and a standardized operating protocol (SOP)	None	An acronym for an SOP and MDS
Christie and Robinson, 2009	QI Project	United Kingdom	All units in a hospital	Mnemonic	Description of QI initiative process	Average length of report; reduction in hospital mortality, reduction in adverse events, reduction in cardiac arrests, reduction in MRSA[††]	Reduction in nurse to nurse handover time (from 45 mins to 7 mins); 11% reduction in hospital mortality; 65% reduction in adverse events; 8% reduction in cardiac arrests; 83% reduction in MRSA[††].

[†]Quality Improvement

[††]Methicillin-Resistant Staphylococcus aureus

[†††]Situation Background Assessment Recommendation

Table 2.1 continued

Author and Year	Type of Study	Location	Type of Unit	Tool Design	Article Focus	Assessment of Impact	Results
Clark et al., 2009	QI Project	Australia	Medical and surgical units	Mnemonic	Description of QI initiative process with measures of improvement	Questionnaires with a series of Likert-scale questions and free response questions given pre- and post-implementation	36% increase in nurses who stated they always get the information they need at handover; 68% of nurses believed handover had improved; 72% agreed handover was more structured after implementation; 72% agreed they now communicate more effectively; 62% agreed the SBAR††† tool helped them to know what to say when communicating with doctors

†Quality Improvement

††Methicillin-Resistant Staphylococcus aureus

†††Situation Background Assessment Recommendation

Table 2.1 continued

Author and Year	Type of Study	Location	Type of Unit	Tool Design	Article Focus	Assessment of Impact	Results
Athwal et al., 2009	QI Project	United States	Progressive Care Unit, primarily cardiac medical patients	Printed template	Description of QI initiative process with measures of improvement	Time spent during report; call lights; staff satisfaction; and patient falls; all measured before and after implementation	15-45 minute reduction in report time; $8000 reduction in overtime costs; reduction in unanswered call lights from 6 to rare; increase in staff satisfaction; falls decreased from 1-2 a month to 1 fall in 6 months;
Wilson, 2007	QI Project	United States	Medical-surgical units	Printed template	Description of QI initiative process with measures of improvement	Percent of information in hospital guidelines for handoff included in report	Results for 19 measures ranged from 10% to 100%. One unit who asked to be included in the study had the greatest percentage rates. Overall success rates varied.

†Quality Improvement

††Methicillin-Resistant Staphylococcus aureus

†††Situation Background Assessment Recommendation

Table 2.1 continued

Author and Year	Type of Study	Location	Type of Unit	Tool Design	Article Focus	Assessment of Impact	Results
Caruso, 2007	QI Project	United States	Medical-surgical cardiology unit	Printed template	Description of QI initiative process	Anecdotal reports	Nurses liked aspects of bedside report, but were frustrated by making patients listen to redundant reports of history. Patients perceived nurses as being professional, organized, and capable.
Alvarado et al., 2006	QI Project	Canada	Pilot for general medicine unit and obstetrical unit before system-wide implementation	Checklist	Description of QI initiative process	Anecdotal reports	Reported improvements in congruency of information received in handover and in patient assessment. Patient satisfaction with bedside check.

†Quality Improvement

††Methicillin-Resistant Staphylococcus aureus

†††Situation Background Assessment Recommendation

Table 2.1 continued

Author and Year	Type of Study	Location	Type of Unit	Tool Design	Article Focus	Assessment of Impact	Results
Davies and Priestly, 2006	QI Project	United Kingdom	Medical unit	Printed template	Reflexive evaluation of handover with a description of a QI improvement project.	Anecdotal reports	Length of handover reduced, efficiency increased. Staff satisfaction with the process improved.
Fenton, 2006	QI Project	United Kingdom	Acute elderly unit	Checklist	Description of QI initiative process with measures	Pre- and post-implementation audits evaluating presence of information,	Significant improvement in 10 of 13 categories of content. Anecdotal reports of staff being generally positive about using the tool. Duration of report comparable pre- and postintervention
Schroeder, 2006	QI Initiative	United States	Medical/surgical unit	Mnemonic	Description of a new handover mnemonic	Anecdotal reports	Elimination of omissions in report, a more concise report.

†Quality Improvement

††Methicillin-Resistant Staphylococcus aureus

†††Situation Background Assessment Recommendation

Table 2.1 continued

Author and Year	Type of Study	Location	Type of Unit	Tool Design	Article Focus	Assessment of Impact	Results
Mosher and Bontomasi, 1996	QI Initiative	United States	Internal Medicine Unit	Spreadsheet	Description of QI initiative process with measures	Survey at 6 months after implementation	Most nurses felt the new method was more effective. Information received was more current, relevant, and updated. Reduction in average length of report from 50 mins. to 20-30 mins.
Baldwin and McGinnis, 1994	QI Initiative	United States	1 medical unit and 1 surgical unit	Printed template	Description of QI initiative process with measures	Questionnaire of nurses post-implementation	High rate of acceptance of the new system. 60% of incidental end of shift overtime had been eliminated.

†Quality Improvement

††Methicillin-Resistant Staphylococcus aureus

†††Situation Background Assessment Recommendation

Table 2.2. Handoff Mnemonics.

Source	Mnemonic	Description
Schroeder, 2006	PACE	P - Patient/Problem A - Assessment/Actions C - Continuing/Changes E - Evaluation
Christie & Robinson, 2009 Clark et al., 2009	SBAR	S - Situation B - Background A - Assessment R - Recommendation
Yee et al., 2009	HAND ME AN ISOBAR	H - Hey, it's handover time A - Allocate staff for continuity of patient care N - Nominate participants, time and venue D - Document on written sheets and patient notes M - Make sure all participants have arrived E - Elect a leader A - Alerts, attention and safety N - Notice I - Identification of patient S - Situation and status O - Observations of patient and call to MET B - Background and history A - Action, agreed plan and accountability R - Responsibility and risk management

CHAPTER 3

METHODS

The purpose of this research is to understand the role of nurses' brains and how they are produced and used by nurses in the context of a medical unit at the Huntsman Cancer Hospital. This study addresses the gap in the research literature by generating a deep understanding of nurses' brains, including the meanings ascribed to brains, how nurses produce their brains, and the functions brains serve for nurses in a medical oncology setting. Further, the content and structure of nurses' brains was examined, as well as how brains changed over time during a shift. The theoretical perspective underlying the research approach is symbolic interaction. The methodological framework is grounded theory. Ethnographic methods consistent with a grounded theory approach were used for data collection, and analysis was conducted using grounded theory techniques.

3.1 Research Approach

3.1.1 Theoretical Framework

According to Crotty (1998), a theoretical perspective is "the philosophical stance informing the methodology [of a research project] and thus providing a context for the process and grounding its logic and criteria" (p. 3). Interpretivism is a theoretical perspective embedded in a constructionist epistemology that "looks for culturally derived and historically situated interpretations of the social life-world" (Crotty, 1998). Within an interpretivist perspective, knowledge is socially constructed and interpreted through cultural and historical lenses. In contrast to post-positivism, which tries to control for context in making objective observation, interpretivism focuses on that context while trying to make meaning of the interactions occurring within it. To understand the meaning of an interaction, the system of meanings to which it belongs must be understood (Schwandt, 2001).

Symbolic interactionism is a class of interpretivism that has its origins in the thought of George Mead (Crotty, 1998; Schwandt, 2001). Mead, a social psychologist at The University of Chicago, was strongly influenced by pragmatist philosophy (Charon, 1998). Pragmatism

emphasizes human agency, consciousness, meaning, and process (Musolf, 2003). Using this perspective, reality does not immediately impose itself on an individual without him/her interpreting it. People define the world around them, not merely respond to it. Meaning is determined by how useful it is in the current situation. This meaning can be discovered by examining what people do in naturalistic contexts (Charon, 1998). This perspective influenced Mead's thinking as he examined the behaviors of people in social context.

Mead claimed that the "self", situated in interaction with the social world, is a product of social interaction and participation within society. Further, the self is made up of the subjective "I" and the generalized "me." The subjective "I" is natural and not hampered by others, and the "me" is an internal construction of what others see. Through inner dialog between these two aspects of self, reflection upon oneself, and taking on the view of the other allow humans to develop a "social self" (Jeon, 2004; Mead, 1970). These beliefs were fundamental to the perspective of symbolic interactionism, though Mead, himself, never used the term. Herbert Blumer, a student of Mead's, introduced the term when he and others published Mead's work after his death (Charon, 1998; Crotty, 1998).

Blumer further developed Mead's ideas and put forth three basic symbolic interactionist assumptions:

> 1. human beings act toward things on the basis of the meanings these things have for them;
> 2. the meaning of such things is derived from, and arises out of the social interaction that one has with ones fellows;
> 3. these meanings are handled in, and modified through, an interpretive process used by the person in dealing with the things he encounters. (1986 p. 6)

Thus, from a symbolic interactionist perspective, meaning comes about through social interaction with others in a culture, and is created by an individual through his/her interactions within a social context. Data are found in the actor's views of their actions, objects, and context. In order to gather data, one must see the world through the actor's eyes–an emic perspective. A researcher should attempt to become part of the social context in which the actor exists—interacting with the actor, seeing things from their point of view, in their natural context—in order to fully understand his/her actions (Blumer, 1986; Jeon, 2004).

The symbolic nature of nurses' brains and the importance brains have to nursing culture influenced the decision to use a symbolic interactionist perspective in the proposed study. In previous work (Staggers et al., 2012, 2011), nurses were shown to create their brains within a context supportive of the importance these objects had for nurses and nursing

practice. The meanings of paper brains were derived from an interactive process with other nurses on the unit through teaching and sharing of brains with other nurses.

3.1.2 Methodology

The methodological framework guiding this study is grounded theory. Grounded theory was developed out of symbolic interactionism and can be considered a specific form of ethnographic inquiry that develops theoretical ideas (Crotty, 1998). Glaser and Strauss (1967) originally developed grounded theory as a means to generate a theory that describes, explains, interprets, and predicts the phenomenon of interest. It is fundamental that the developed theory is grounded and derived from data (Glaser & Strauss, 1967; Jeon, 2004). The hallmarks of a grounded theory approach include the specific methods of theoretical sampling, constant comparative analysis, codes and categories derived from the data, analytic memo writing, and theory generation (Glaser & Strauss, 1967; Munhall, 2007; Schwandt, 2001). These processes occur simultaneously throughout the research project, occurring in a "zig-zag" between data collection in the field, analysis in the office, and back, until a substantive theory is developed (Creswell, 2007).

3.2 Study Design

The grounded theory approach provides a lens through which to examine the meaning nurses ascribe to their brains, how brains are produced, and what functions they serve in nursing practice.

3.2.1 Setting

The setting for this study was the medical oncology unit in the Huntsman Cancer Hospital located within the University of Utah Health Care system in Salt Lake City, Utah. This hospital was chosen because the researcher had prior experience conducting research in this setting, and nurses working in the medical unit had demonstrated interest in participating in future research studies. In addition, focusing on a single unit allowed for a complete understanding of nurses' brains, without the need to fully understand multiple cultural contexts.

The Huntsman Cancer Hospital is a 50-bed cancer-specialty hospital that provides care for thousands of patients each year (http://www.huntsmancancer.org/about-us/about-us, retrieved April. 12, 2014). The medical unit in the Huntsman Cancer Hospital employs approximately 35 nurses. In addition, the medical unit utilizes float nurses. These nurses are available on an ad hoc basis and are not considered officially employed by the unit. An

accurate number of float nurse used by the unit was unavailable. The medical oncology unit is also a clinical teaching site for The University of Utah College of Nursing, providing a location for advanced nursing students to practice clinical skills under the supervision of licensed registered nurses.

3.2.2 Participants

The participants in this study were nurses working in the medical oncology unit in the Huntsman Cancer Hospital. A theoretical sample was used to select nurses for recruitment into the study. Theoretical sampling is "a method of data collection based on concepts derived from data" (Corbin & Strauss, 2008, p. 144). Thus, it is concepts that are sampled, not participants. Theoretical sampling is about discovering relevant concepts, not testing or verifying hypotheses, and is an integral part of the constant comparative method as applied in grounded theory. As data collection and analysis cycle back and forth, new concepts and questions arise. The researcher looks for additional sources of data to sample that may address these questions, ensuring the theory developed is rooted in the data collected (Corbin & Strauss, 2008; Glaser & Strauss, 1967; Sandelowski, 1995). This differs from statistical sampling that establishes a more rigid plan before research begins, and aims to gather individuals representative of the population. Theoretical sampling is cumulative in that each successive data source sampled builds on previous data collection and analysis, and leads to the next.

3.2.3 Sample Size

According to Sandelowski (1995), a balance must be struck between a sample size that is small enough to be achievable given available resources and large enough to give sufficient information about the phenomenon of interest. The sufficiency of information can be evaluated using an assessment of data saturation. Data saturation occurs when new data no longer provide new information about the phenomenon under study (Bernard, 2006; Creswell, 2007; Munhall, 2007), or when all the concepts in the theory are defined and explained in sufficient depth and breadth (Corbin & Strauss, 2008). Saturation in this study was determined to occur when no new categories were created during data analysis, and data collection no longer added depth or breadth to existing concepts. Data saturation occurred more quickly than originally expected, thus only 13 of the planned 20 shadowed observations were needed.

3.3 Data Collection

3.3.1 Field Observation

3.3.1.1 Participant Observation

Participant observation is dependent on first-hand experience in a naturally occurring context. It is a part of fieldwork that generates understanding of the life and experience of others. A researcher spends a somewhat prolonged period of time in a naturalistic setting and takes some part in the daily activities of those under study (Schwandt, 2001). Wolcott (2008) prefers to use the label "experiencing," rather than "participant observation," because it "calls attention to what one is expected to do to accomplish [it]" (emphasis in original) (p. 48). Gaining access to the meaning of social actions through empathic identification of the observed group is a major aim of participant observation. The researcher aims to become socialized into the group, at least in part, encouraging understanding of the nature, purpose, and meaning of some phenomenon within that group (Schwandt, 2001). The hallmark of participant observation is direct observation in the natural context of the phenomenon under study, but can also include informal interviews, reflection, and interpretation by the researcher. Observations are recorded in field notes and analytic memos for access during analysis away from the field (Creswell, 2007; Hammersley & Atkinson, 2007; Schwandt, 2001; Wolcott, 2008).

In the study, participant observation began in an informal way, by "sitting back and letting the scene unfold" (Corbin & Strauss, 2008, p. 30) while on the medical oncology unit. The researcher would arrive half an hour prior to the beginning of a shift and would "hang out" in the nurses station. This time allowed the researcher to get a feel for the social context of the unit, and how nurses' use of brains fit into that context. During this period, nurses had time to "get used to" having the researcher in the unit and reduced the tendency for nurses to modify their actions when the researcher was present. Observations focused on events surrounding the use and production of paper brains. The researcher recorded what was happening and who was involved in field notes. In some cases, the researcher asked questions of those involved as part of the observation. Immediately following each observed shift, the researcher wrote in-depth field notes and analytic memos, reflecting on what was observed during that session, including interpretations, implications, and arising questions for future interviews. The field observations were also used to identify nurses who were candidates to participate in shadowing observations. Individuals who seemed particularly able to address research questions or elaborate on emerging concepts were approached by the researcher for participation in shadowing and formal interviews.

Observations occurred during all shifts (day, evening, and night). Each observation during this period began approximately 30 minutes prior to a scheduled shift. All but two observation periods ended at least an hour after the shift finished. These two observations were cut short due to circumstances unrelated to the study. A total of 73 hours of general field observations were completed between August and December 2012. Table 3.1 shows total hours of observation by shift and day of the week.

3.3.1.2 Shadowing

Shadowing is "observing [a participant] as they move, over time, between different contexts that form part of their lives or their work" (Hammersley & Atkinson, 2007, p. 39). By shadowing a participant, a researcher can learn about how behaviors may differ across different contexts through which a participant moves (Czarniawska, 2007). In this study, the researcher observed nurses creating and using their brains in different contexts by shadowing participants during an entire shift. Shifts in the medical oncology unit are of 8- or 12-hour duration. Both shift lengths were observed. Observations began at the start of a participants' shifts when they began creation of their brains, or at the beginning of intershift handoff, whichever occurred first. The researcher then shadowed the participants throughout the shift, taking note of when and what was happening when nurses accessed their brains.

Thirteen nurses were approached for participation in shadowing observations–none declined participation. These nurses were selected to represent the variety of different brain formats and nurse experience levels on the unit. Though students were observed during general field observations, no students were available while shadowed observations were taking place. In addition, because of a change in the patient population served by the unit, no float nurses were available for shadowed observations. Thus, all nurses approached for shadowing observations were staff nurses employed by the unit.

Informed consent was obtained from each nurse prior to the observed shift. Patients assigned to the participant during the shift did not need to provide informed consent because all data (i.e., copies of nursing brains) were de-identified of any protected health information (PHI) prior to leaving the hospital unit. However, permission to observe the nurse while providing care was obtained from each patient at the beginning of the observed shift. No patients refused permission for observation, in general; however, in three instances, the researcher temporarily suspended observation at the request of three different patients due to procedures of a sensitive nature for the patients. During these periods, the researcher waited outside the patient room for the nurse, and observations resumed once the procedures

were complete. The total time when observations were suspended was less than 3 hours of the total 129 hours of shadowed observation. Table 3.1 shows the total hours of shadowed observation by shift and day of the week.

3.3.2 Field Notes

While observing nurses on the unit, the researcher gathered field notes. There is no standard definition for field notes or their content and form. Researchers use field notes to record observations from the field, as well as thoughts, impressions, and issues to pursue as research continues. They are personal and reflective of a researcher's individual style of conducting fieldwork, and are a significant source of information for the final write-up of research results. Field notes are necessarily dynamic because a researcher's knowledge of the phenomenon of interest changes as research proceeds. Preparing field notes is interpretive and is not just an objective recording of occurring events. Thus, collecting and analyzing field notes is an important process of generating the final research report (Corbin & Strauss, 2008; Glaser & Strauss, 1967; Schwandt, 2001).

Field notes in this study included reports of events and interactions of interest, as well as individual interpretations and possible meanings these events might have had for participants. Immediately following participant observations and shadowing, the researcher reviewed and expanded information gathered in field notes into an electronic document that was later analyzed with other forms of data. Field notes were closely tied to field observations temporally and in intent. Observations and insights made during analysis away from the field were recorded in analytic memos.

3.3.3 Artifact Collection

Artifacts are the physical objects that individuals interact with in their social context (Hammersley & Atkinson, 2007). Artifacts were an important data source in this study, as nurses' brains are considered artifacts and describing their content and structure was a specific aim. Digital scans of brains were collected from participants who agreed to be shadowed. Scans of their brains were collected at four time points during the nursing shift: 1) immediately before the participant received handoff, 2) immediately after nurses received handoff and indicated they were ready to begin patient care, 3) immediately before giving handoff to the following shift of nurses, and 3) immediately after the participant completed giving handoff. These time points occur at natural breaks in the nursing shift and allowed examination of the original content and structure of brains, any changes made to brains during the shift, and any additional changes made while giving handoff to the next shift.

Interrupting a nurse's shift more frequently had the potential to disrupt workflow, impeding the observation of nurses using their brains in a naturalistic way.

3.3.4 Interviews

Interviews in qualitative research, including grounded theory, come in a variety of flavors (Corbin & Strauss, 2008; Hammersley & Atkinson, 2007; Schwandt, 2001). In this study, both informal and formal interviewing occurred, and were both unstructured and semistructured. Informal interviews in the form of spontaneous conversations in the course of other activities occurred during both participant observation and shadowing.

Formal interviews—arranged meetings conducted away from other individuals—were conducted with individual shadowed nurses immediately following the observed shift and were audio recorded. All interviews were held in a conference room adjacent to the nurses' station, and ranged in length from 20 minutes to 2 hours. These interviews were semistructured as they were used to explore concepts that arose during initial participant observation. Open-ended questions were used to initiate discussion regarding the information content, structure, production, and development of each participant's brain. These questions asked nurses to describe the content and layout of their brains, how they learned to make their brain, how their brain had changed during their time as a nurse, and how their brain affected their nursing practice. The researcher used further probes to fully comprehend the participants' understanding of their brains, asking for clarification of specific words and phrases, and following up on new ideas that arose during conversation (Creswell, 2007; Hammersley & Atkinson, 2007; Morse & Richards, 2002). The nurses' paper brains were used during the interviews to help elicit responses from the participants.

3.4 Data Management

All data were digitized and saved on the University of Utah data server and accessed using a password-protected desktop computer. The data server was encrypted and backed up regularly, so data were confidential and protected from loss due to disk failure.

3.4.1 Field Notes and Analytic Memos

The researcher transcribed all field notes and analytic memos written in the field to a rich text file.

3.4.2 Audio Files

Audio files of interviews were transcribed to a rich text file by professional transcriptionists. These transcripts were compared to the audio files for accuracy and missing words by the researcher, then de-identified by removing all PHI and any identifying information for providers and participants.

3.4.3 Artifacts

Digital scans of brains, and any original brains or other documents, were de-identified by blacking out patients' PHI with opaque boxes in the digital files. Original analog artifacts will be stored in a locked file cabinet at the College of Nursing until the end of the study when they will be shredded.

Transcripts of audio files, artifact images, and field notes were collected into an Atlas.ti (Muhr, 1997) database for coding and analysis.

3.5 Data Analysis

Specific Aim 1 was addressed with traditional methods of a grounded theory approach including theoretical sampling, constant comparative analysis, codes and categories derived from the data, and analytic memo writing. The results from the grounded theory approach were used to generate a list of functional and technical requirements for a successful electronic brain to address Specific Aim 2.

The signature methods of theoretical sampling, constant comparative analysis, codes and categories derived from the data in multiple phases, and analytic memo writing were used. The process of grounded theory is illustrated in Figures 3.1 and 3.2.

3.5.1 Constant Comparative Analysis

Constant comparative method of analysis was described by Glaser and Strauss in 1967. Using this method, a researcher employs induction, deduction, and verification concurrently through cyclical data collection and analysis. As concepts emerge through initial analysis, they are compared to previous data collected and analyzed. This generates insights, hypotheses, and questions that are addressed in further data collection, until all concepts are fully explored (Corbin & Strauss, 2008; Glaser & Strauss, 1967; Schwandt, 2001). In some approaches to research (e.g., experimental designs), data collection and analysis occur in stages, driven by a clearly defined research question developed during study design. In contrast, the constant comparison method is much more open. Using this approach, the final research question emerges through the cyclical process of data collection and

analysis. In grounded theory approaches, the purpose of comparisons is not to describe and verify comparisons themselves, but rather to aid conceptualization and categorization in the course of data collection and analysis. The making of constant comparisons ensures that one constructs an understanding that is grounded in the data (Creswell, 2007; Glaser & Strauss, 1967; Jeon, 2004). Constant comparison analysis occurs through all phases of data coding and analysis. The constant comparative method was applied throughout the study, beginning with initial field observation. Data in all forms, once collected, were scrutinized using Open and Axial coding.

3.5.2 Codes and Categories Derived from the Data

Saldaña (2009) defines a code in qualitative inquiry as "a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data" (p. 3). Coding using grounded theory techniques occurs in multiple phases. The first phase is called "Open" or "Initial" coding. Open coding consists of breaking down the data into discrete parts and examining them for major categories of information. It is an open-ended approach and the researcher is encouraged to remain open to all possible theoretical directions indicated in the data. There is a variety of coding techniques available during open coding. For this study, "in vivo", in which actual language used by participants is used as labels for data, and "process" coding, in which action words (e.g., ending in "ing") are used as labels, were chosen to maximize the use of the nurses' own words and to highlight the creative nature of brain development and use. From this process, a second phase emerges utilizing "Axial" coding. Axial coding arises from reviewing the results of open coding to obtain a core phenomenon(s), or category(s), apparent in the data. During this phase, categories are related to subcategories, and properties and dimensions are specified. The properties and dimensions refer to the conditions, causes, and consequences of a process. Axial coding occurs between Open and "Theoretical," or "Selective" coding. Theoretical coding was not completed in the course of this study (Corbin & Strauss, 2008; Creswell, 2007; Glaser & Strauss, 1967; Saldaña, 2009).

3.5.2.1 Analytic memo writing

Analytic memos are similar to researcher journal entries. They are a place to record thoughts about the study's participants, the phenomenon of interest, or process under investigation. Writing memos helps the researcher to be analytical and reflective, as well as to retain and elaborate thoughts and striking ideas. This analysis and reflection is crucial

to the constant comparative method, and ties together the processes of data collection and analysis (Jeon, 2004; Saldaña, 2009).

Analytic memo writing in this study began with initial participant observation and was used throughout the study to generate ideas, explore thoughts and interpretations, and evaluate and reflect upon the activities of the study.

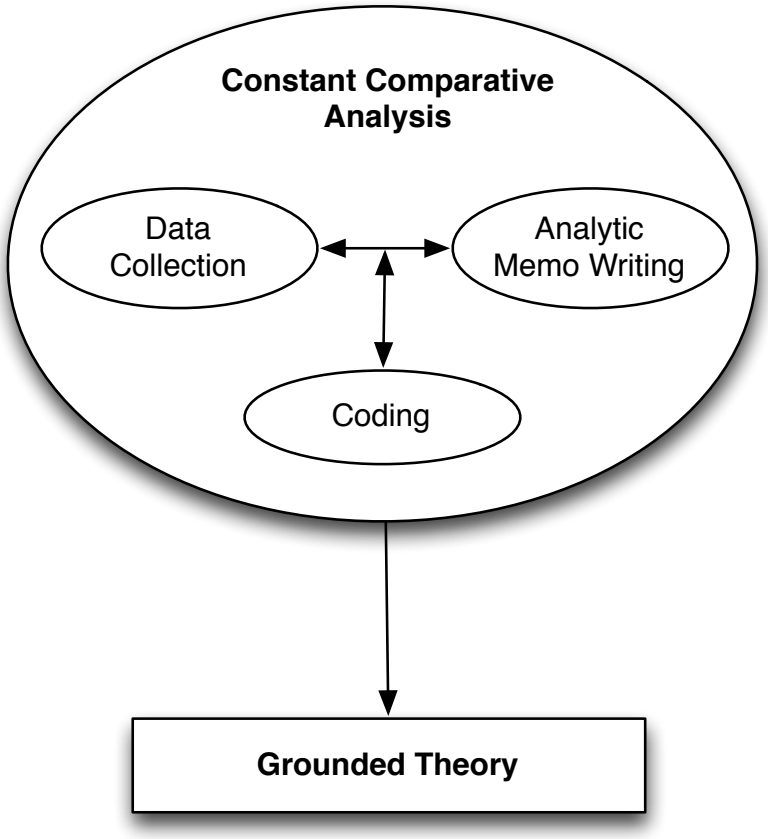


Figure 3.1. A Model for Developing Grounded Theory.

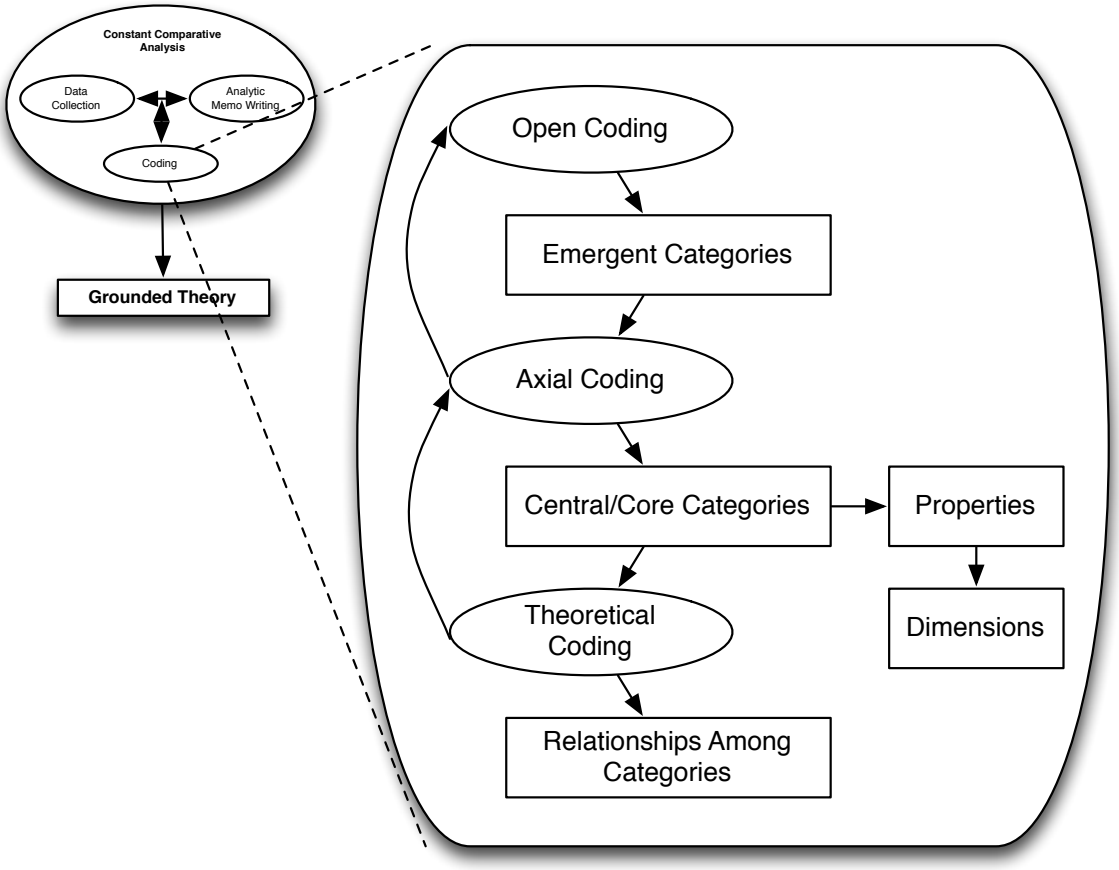


Figure 3.2. Detail of a Model for Developing Grounded Theory.

Table 3.1. Total Hours of Observation

		General Field Observation	Shadowed Observation
Shift			
	07:00-15:00	9	15
	07:00-19:00	30	86
	15:00-23:00	23	16
	19:00-07:00	11	12
Day			
	Weekday	53	108
	Weekend	10	21
Total		73	129

CHAPTER 4

RESULTS

The results of this study are organized to address the four main findings: brains provide cognitive support, brains are a representation of nurse identity, brains represent the patient, and brains are living objects. Section 4.2 presents how brains provide cognitive support through different types, content, and organization within patient. Section 4.3 reports how brains are a representation of nurse identity. Section 4.4 explores how brains represent the patient both as a physical object and through the "story of the patient." In Section 4.5, brains are described as living objects, manifesting characteristics of a life cycle during a single shift and evolution across a nurse's career.

4.1 Description of the Sample

A total of 73 hours of general field observations were completed between August and December 2012. A total of 129 hours of shadowed observations were completed across 13 nurses between February 2013 and July 2013. Table 3.1 shows total hours of observation broken out by shift and day of the week. All 13 shadowed participants were staff nurses on the medical oncology unit at Huntsman Cancer Hospital. The median length of nursing experience was 4.5 years, ranging from 7 months to 34 years. Experience on the unit ranged from 6 months to 34 years, with a median of 4 years. The majority of nurses held Bachelors degrees, although 2 nurses held Associate degrees and 1 nurse had a Masters. All but 1 nurse were female. Pseudonyms are used throughout the results to protect the identity of nurse participants.

4.2 Brains Provide Cognitive Support

Paper brains have been described as cognitive artifacts (Collins et al., 2011; McLane et al., 2009, 2010; Randell et al., 2010). As such, paper brains provide cognitive support of nursing practice as a place to store information for later retrieval, to list tasks, and to organize and prioritize those tasks for efficient and safe patient care. However, this content

must be presented in a manner that works with a nurse's way of thinking about patients and nursing practice. Despite this individuality, paper brains have general types that reflect these differences among nurses, and content varies across brain types. In this section, brain types will be described first, allowing differences in content across types to be explored.

4.2.1 No Need to Reinvent the Wheel: Paper Brains Have Types

As described in previous studies (Staggers et al., 2011, 2012), nurses' paper brains are individualized. Nurses in this study explained that the process of synthesizing information and the way it was represented on the page was specific to the individual. They recognized that information included on their brains was likely very similar.

> **Keira:** I think everybody's brains work differently, as in their literal brains, and so they process things [differently], some people are more like visual and they like things spaced out a certain way. Some people like it to be like super condensed and tiny handwriting, and I hate that, and so if that were the case, like I couldn't do that. And I think that's why so many different styles have evolved, because people want them to be their own and to reflect like how they function, how they work, how they view things. So, I don't think one standard thing would ever work...Like, if some people are very like regimented and they like things like in boxes and stuff and other people just like to like free-flow and write everywhere, those different styles aren't going to agree on the same type of form, so.

> **Mary:** It's not that we're so unique; we all need the same information, but we are unique in the way we process it and we synthesize it.

Though no two brains in this study were completely identical, all the brains could be categorized into three general designs: 1) hand written free-form, 2) preprinted templates or skeletons, and 3) the Nursing Summary Report generated by the EHR. All brains, regardless of design, have internal consistency within the individual nurse across patients. In other words, none of the nurses would have one template for one type of patient and a different template for another type of patient. A blank brain represents part of a nurse's schema of all potential patients. Data for specific patients assigned for a shift would be copied from the EHR into the individual format using an old paper brain if a nurse had previously cared for a patient, and from report given during handoff.

4.2.1.1 Free-Form

Free-form paper brains are hand-written by the nurse without a preprinted structure. Four of the 13 nurses interviewed used a free-form brain at the time of their interview. An example is shown in Figure 4.1. Free-form brains generally began as a blank piece of paper taken from a laser printer on the unit. However, 1 nurse on the floor used a page designed

for progress notes for the defunct paper charting system. This page was lined and labeled "Staff Notes" at the top. Free-form brains could be oriented portrait or landscape on the page, and were created so information for 4 to 6 patients would fit on a single piece of paper. Nurses wrote information for multiple patients on their brains so only one sheet of paper would need to be carried with them during the shift. These areas were separated by either folds, lines drawn by the nurse, or both. Lines were drawn free-hand, or using a make-shift straight edge like another piece of paper or a laminated telephone reference card from the nurses' station. Patient sections were made before or during safety rounds, and were always ready by the time the nurse received her first report during handoff.

Though free-form brains began as a blank piece of paper, they had a definite, stable structure for the location of written information. This structure was consistent across patients and across shifts. For example, a nurse might always write the patient's name, age, and room number in the upper left corner, and the most recent laboratory values along the bottom in the center. This structure was apparent to the nurse who created the brain, but not necessarily to other nurses on the unit. Zoe, a well-respected nurse with more than 30 years of experience, used a free-form brain. Two other nurses on the floor explained, "She just writes stuff," and "She just writes things down anywhere." Though others could not readily see how she structured her brain, Zoe was easily able to describe how it was organized when asked to do so.

4.2.1.2 Skeletons

Skeletons are paper brains that begin as blank templates and were the most common type of brain observed on the unit (7 of the 13 nurses interviewed). An example can be seen in Figure 4.2. Skeletons generally have sections designated by lines or boxes for different types of information. These sections could be labeled or unlabeled. Information would be filled out in pen or pencil by the nurse at the beginning of the shift. Several photocopies of blank skeletons were kept in nurses' lockers. A single blank skeleton would be pulled from the locker before report to be used as the shift's brain. Like free-form brains, skeletons could be oriented portrait of landscape on the page. Generally, skeletons were double-sided and designed so four to eight patient areas were printed on a single piece of paper; however, one skeleton originally created for the Bone Marrow Transplant unit was designed with only a single patient on each page.

4.2.1.3 Nursing Summary Report

The Nursing Summary Report is a form generated by the EHR that was designed for the hospital to be used for nurse handoff in acute care units. This type of brain was used least often by nurses on the unit—only 2 of the 13 nurses used the Nursing Summary Report exclusively, and 1 nurse, Mary, was using both the Nursing Summary Report and a free-form brain. Figure 4.3 shows an example of a Nursing Summary Report. The report is designed to be printed portrait-oriented on a single letter sized piece of paper, one patient per page. Different categories of information are printed in sections separated by lines. For example, the last five sets of vital signs are printed in one section, and medications and orders are printed in another. Every nurse who used the Nursing Summary Report wrote additional information on the form prior to and/or while receiving handoff.

Some information printed on the Nursing Summary Report was often rewritten by the nurse. One example was lab results. Lab results printed on the summary report are displayed in an alphabetical list and are not clearly grouped into related tests. Individual results of complete blood count (CBC) and basic metabolic panel (BMP) tests were mixed together in this list. Every nurse who used the Nursing Summary Report would recopy those values into a fishbone diagram drawn elsewhere on the page (see Figure 4.4), allowing inferences to be made through the visual grouping of data. Diet orders were another type of information rewritten to be easily referenced by the nurse while on shift. In addition, depending on the complexity of the patient, some orders may not print to the Nursing Summary Report because of lack of space. Nurses would review those orders in the EHR and add pertinent orders to the printed form by hand.

4.2.2 We All Need the Same Information: Brains Have Content

The content of paper brains in this study fell into 21 broad categories:

- Patient Identification
- Admission Demographics
- Alerts
- Problems
- History
- Patient Preferences
- Physical Findings and Assessment

- Equipment
- IV Access
- IV Fluids
- Consultations
- Procedures
- Protocols
- Vital Signs
- Intakes and Outputs
- Pain
- Medication Orders
- Other Orders
- Lab Results and Cultures
- Tasks and Reminders
- Contact Information.

Table 4.1 lists the total number of brains that contained each item. Every type of brain contained information from each category; however, the Nursing Summary Report printed some information not seen in any of the free-form or skeleton brains. These included patient identifiers like medical record number, admission demographics like unit and hospital name, and many lab results. Information not printed on the Nursing Summary Report that was handwritten by the nurse included a detailed medical history, IV access, assessment, and orders missing due to lack of space.

Individual data items were grouped roughly into these categories within each patient. However, all but one skeleton brain and every free-form brain had an area displaying data items from across multiple categories that gave a picture of patient context representing the "story of the patient" as described in later sections. Patient identification, admission demographics such as room number, diagnosis, and reason for admission were nearly always presented together. Alerts were grouped with this information as well, except in Nursing Summary Reports where alerts such as fall risk and one-to-one observations were printed

among patient care orders. Nurses would recopy or highlight this information to make it more visible. The information in free-form and skeleton brains were described in interviews as being ordered according to how information was presented when giving handoff.

Along with these categories, every brain had a schedule of medications due and other time-sensitive tasks. Schedules were either made for each individual patient or collected into one comprehensive schedule with all patients combined. Two general formats were observed for the single-patient variety. In the first format, seen in Figure 4.5, every hour of the shift was displayed with an indicator of a medication or task due for a subset of the hours. Indicators were either a simple visual like a checkmark or circle around the hour label, or the name of the medication or task. Medication names were often spelled out especially if medication had a specific preparation or was particularly time-dependent. Examples given were medications needing to be resuspended in a liquid, and time-sensitive antibiotics. A schedule listing all hours of a shift was exclusively used on skeleton brains. Six of the seven skeletons had schedules of this type (see Figure 4.5).

The second form of single-patient schedule displayed a list including only the times the patient had a medication or task due (see Figure 4.6). Again, indicators of tasks or medications due were either simple boxes or spaces to check off or the names of medications of tasks spelled out. The limited list schedule was used by 2 of the nurses with free-form brains and 2 of the nurses with the Nursing Summary Report.

The comprehensive schedule included all patients and took the form of a grid with the hours of shift along one axis and the patients labeled by room number, name, or both along the other axis (see Figure 4.7). The comprehensive schedule was seen on one free-form brain and one skeleton. This skeleton was the only one of the seven skeletons that was not identical on each side. Mary, who used both the Nursing Summary Report and a free-form brain, used both the limited list for each patient, and a comprehensive schedule with all patients included. Mary indicated in her interview she added the limited list to her free-form brain in addition to the comprehensive schedule only when using the Nursing Summary Report.

4.3 It's a Part of Me as a Nurse: Brains Are a Representation of Nurse Identity

The support paper brains provide goes beyond mere information retrieval. Not only are nurses' brains individualized as described in Section 4.2.1, but brains are also personal representations for the nurse and act as a means to assert autonomy in a larger healthcare system. Many nurses, especially those who used free-form or skeleton brains, would talk about how their brains were an expression of themselves and how they think.

> **Jane:** I just feel like this is my personal—like no one—it's no one else's.
> **Interviewer:** As you hug that to yourself.
> **Jane:** Exactly, yeah... Like I'm giving you a piece of myself there with my brain.

Sharon felt similar and said without her brain she could not practice, and would have to retire, adding, "Like this is my brain... And so, yes, it's a part of me as a nurse." Nurses who used the Nursing Summary Report indicated their brains represented them as a nurse to other providers and their patients.

> **Keira:** When the patients are asking a question, like, "Oh, what were my counts today?" I say, "Well, let me look," and I pull out my paper. And so that's impressive to them to know that I already looked it up and I have it written down.

Similarly, a nurse who was floating to the medical oncology unit during field observations felt the Nursing Summary Report looked more professional to others than anything handwritten.

Physicians and other providers were also observed carrying papers with them containing patient information during a shift; however, these were not viewed as personal, i.e., as representing the person who used them. For physicians, physician assistants, and nurse practitioners in particular, these papers were printed documents from the EHR, such as the History and Physical, or Progress Notes. These papers were referred to as "notes" by those carrying them, and had fewer handwritten pieces of information compared to nurses' brains. These notes clearly were not viewed as personal as shown in an interaction observed during morning rounds between an attending physician and a resident. The resident in this case had printed multiple documents from the EHR for the patient being discussed, including several pages of EKG output. All the pages had been stapled together. While discussing the patient, without asking permission, the attending took the packet from the resident and pulled each page from the staple, spreading them out on a rolling desk in front of him. After finishing the discussion, the attending gathered up the resident's papers in a different order than they had been stapled together, and handed them back to the resident. The resident did not seem upset by this, though the attending did utter a quick apology as he handed the papers back and headed into the patient's room. This exchange was disconcerting because treating another nurse's brain in such a way would be a tremendous breach in etiquette. Though nurses shared information from their brains by showing them to others, a brain was never taken from another's possession.

Nurses respected the difference among other nurses' brains, acknowledging the importance of allowing individuals to express themselves in their work.

> **Interviewer:** Do you think it's important to maintain that individual reflection of personality [in your paper brain]?
> **Keira:** Yeah. I think it's directly connected to how you feel about your job, too, because if you felt like everyone's making me do this, but I'm not that way and I don't like doing it that way, then you're going to feel like you're the odd one out and you're the one that's being made to conform. So, I think it is important to let people have their own style.

Keira was not the only nurse to discuss the connection between paper brains and job satisfaction. Olivia and Mary also discussed how their brains expressed their autonomy as nurses. Olivia mentioned while being shadowed that using her own individualized brain was a way to "thumb her nose at the administration" and maintain autonomy in her practice. She was open to changes suggested by the organization that might enhance patient care, but forcing her to use a different brain was not the way to do it: "I don't like arbitrarily being told what to do. I like autonomy." Mary, who was trying to use the administration-supported Nursing Summary Report instead of her free-form brain, was clearly uncomfortable with the change. She saw the Nursing Summary Report as a representation of what the hospital administration viewed as a good nurse, though that view did not mesh with her own identity as a nurse. In her interview, she discussed trying to reconcile the differences between the Nursing Summary Report and her own nursing practice:

> **Mary:** Sometimes I feel like... what I end up prioritizing as a nurse here is very different from what is prioritized on other units. So it's like, well, if I get used to using this [Nursing Summary Report], maybe I'll be a more efficient nurse. Because I'm listening to [the nurse manager] talk about how we're not managing our time well, and how we should be able to carry bigger patient loads. And I'm like, well, you know, if all I paid attention to, to some extent, was the information that they feel is important enough to include in the nursing summary, maybe I could use my time more efficiently. But then, if all I do is use what actually appears in the nursing summary notes, even if I highlighted them, most of what I need to get done that ensures that my patient gets a relatively safe experience will never happen. So I'm trying to use this and maybe get back in touch with what the administration thinks is a good nurse.
>
> [I give report from the Nursing Summary Report] because I have noticed that there are some things that I don't consider that important, but that appear here [on the Nursing Summary Report], and I don't want to be remiss in telling somebody about, in the event that they, too, might find that important, where I would take for granted that they would know it... So I do use it to remind me that there are sometimes things that I need to pass along that I think are either self explanatory or not as important as the other things that I'm going to tell you about.... Right now I am really– I'm trying to make sure that what I'm giving [in report] is part of the party line.... But this way necessitates me having stuff here, stuff here, stuff here, and more stuff here [points to several

> areas on the front and back of her Nursing Summary Report], because what I usually do is I usually pull it out [and copy it to my free form brain] in my schedule and... [list of patient] problems. And that's usually what I work off of [during my shift]. And it works much better for me.

Mary's discomfort with using the Nursing Summary Report is clear in her interview and demonstrates a disconnect between its structure and how she practices nursing.

4.4 I Almost Hugged Mine: Brains Represent the Patient

Paper brains are a representation of nurses' patients beyond mere information. For some nurses, paper brains act as a physical manifestation of the patients themselves. Brains are also a place to save a narrative representation of the story of the patient.

4.4.1 Brains Are a Physical Representation of the Patient

Nurses, especially those who used free-form and skeleton brains, described looking at their paper brains to help them visualize their patients in their minds. Betty and Jane both described using their paper brain to generate an image of each patient while charting results of adult patient assessments. Both indicated that if they could tie the information to an image of the patient, they could remember the actual assessment and chart more accurately. This was true even though the results of the assessment itself were not written on the paper brain. For Violet, the structure of her paper brain represented the physical location of each patient's room:

> **Violet:** So anyway I think that's why I [take report] in pencil, and so with my type A I just feel like not to have this and have it organized, it just bugs me and it throws me off. Or if they change the schedule or change my patient list and I've already written stuff down but the room order is messed up, that bugs me too. So I would have to either erase it or get a new sheet. But, [when I pick up a new admission] even then, say I started with four patients and then this [patient list] was going to be out of order, I would skip this box and go down to here....Because it has to be in order of where the patients are in my mind and on my paper clearly.
> **Interviewer:** Do you picture the rooms in your mind when you're looking-
> **Violet:** I think so. Yeah.

In a particularly poignant conversation, Sharon was able to illustrate how her brain was almost a material extension of her patients. Sharon made an affectionate gesture toward her paper brain. When asked about it, she began to discuss how she feels about her patients.

> **Interviewer:** Okay, so this movement that you just did is really interesting, because I think every single person [I've interviewed] has either petted their brain or hugged it or made some–.
> **Sharon:** I almost hugged mine! Well, I think, you know, I mean you and I

> have talked about this today, like at least the nurses here on [our unit], I mean it's more than a job. You know, this is our heart, and these patients are our families. They're our second families, and it's just amazing to me that you can meet somebody the first time and really like love them that profoundly, you know? I don't think I've ever really had that experience more than maybe a couple times in my life outside of being a nurse, but I can– these people, like I genuinely love most of them, and so when people come and make changes to our work, it's hard to not take it personally.

The affection Sharon feels toward her patients was mirrored in the affectionate gesture she made toward her paper brain, indicating a tangible representation of her patients on the paper.

4.4.2 Painting the Picture: Brains Hold the Story of the Patient

At the heart of the representation of a patient is the story of the patient's hospitalization. Five of the nurses explained during interviews that their paper brains provided a means to construct and store a "story of the patient" central to the care they provided. Oncology patients frequently have long disease trajectories spanning multiple hospitalizations. A patient's cancer trajectory can be compared to an epic story comprised of multiple books. Each book in the epic can be thought of as a single hospitalization. As a book is made up of individual chapters, each hospitalization is made up of shifts. Each shift can then be thought of as a chapter written from the point of view of the nurse caring for the patient.

> **Jane:** Because I think that's what we need is the important stuff, the basics, to paint the picture.
> **Interviewer:** Okay. Can you talk a little bit more about painting the picture?
> **Jane:** Yeah, I mean we kind of do that [at report] when we give the history and we give the plan and we give how they've progressed through the day, you know? I mean I think as we– at least when I have a patient for three days in a row, I can kind of give– tell where they came from, like this is– the first day, they had this and this and this done, and the next day, they had this, and you can kind of see a progression either for better or for worse when you– it just helps.
> **Interviewer:** Like a story?
> **Jane:** Yeah, yeah. Yeah, their story of hospitalization, I guess.

The nurse's brain is a tool that allows a nurse to construct the story for each chapter of a patient's hospitalization and tell that story to the next nurse caring for the patient. The story of the patient is initiated at the beginning of a shift during the creation of a nurse's brain and is updated throughout the shift. Information about the patient is gathered from several sources. These sources include discrete data from the medical record (e.g., previous lab values and prescribed medications), text-based information such as the medical history and procedure notes written by physicians, report from other nurses during handoff, and

the nurses own mental schema developed through education and experience. This gathered information is synthesized by the nurse into a narrative about the patient that is central to their nursing practice. Mary explained that the story was at the heart of how she would care for her patients. Knowing what had occurred for the patient previously was directly related to how they would progress during her shift:

> **Mary:** We want to know, what have they had, like, what non-cancer-related illnesses have they had, because that can impact their treatment now. Plus when was the last time they got chemo? What was the chemo? Did they have any complications with that? Have they been to the ICU before? There's some chemos that for instance, bleomycin or something, that will– can cause pulmonary fibrosis, and if they're in for another round of chemo, and they've been neutropenic before, and they've had neutropenic fevers and they've gone to the unit, chances are good they're going to go there again.

The paper brain provides a place to record this information and acts as a representation of this nurse-constructed story of the patient as is evident in Violet's brain, shown in Figure 4.8. This brain is designed with a space at the center of each patient area. In this space, Violet wrote down a variety of information giving the context of her patient. Information included IV line information, physical observations to watch for problems, medical history that may be pertinent for this admission, and indicators of how the patient had progressed so far and how s/he might progress during the upcoming shift. All brains contained the contextual information that indicated a synthesized story, but brains belonging to Felix, Zoe, Mary, and Sharon, in addition to Violet's, displayed singular areas specifically for varied information that taken together told a "story of the patient".

The link between the paper brain and the story of the patient is also indicated by the reproduction phase of life cycle of the brain discussed later. Nurses reported keeping their brains after a shift because they were likely to see those patients again. The brain was not deemed ready for destruction until the chapters of the patient's story written by a particular nurse were finished.

The paper brain provides a space for nurses to store this nurse-constructed story as a whole that is not available to them in formal documentation. The current EHR on the unit was described by nurses as several disjointed screens of data without an easy means to synthesize across pages without the help of a paper brain. Nurses perceived the EHR as being "medical focused," and expressed a need for "just the basics" to provide a "snapshot," or "picture" of the patient.

> **Mary:** [The Nursing Summary Report] doesn't have history, it doesn't tell us that he had squamous cell carcinoma, and I did mention to [the PA]... I said, "do we think that it's anything from his previous cancer," and she didn't really

> give me an answer. But it's important to have a medical history there and we don't have any– like, this [nursing summary] report has nothing about a medical history. And if you look at a lot of our brains, I guarantee you that a significant portion of this space will be dedicated to their past medical history.

Mary further discussed that she had not needed a paper brain before the EHR was implemented on the unit:

> **Mary:** [I've been] on this unit for eight years, yeah... For a long time, we had Kardexes, and so you just didn't write it down. Like you wrote down other– you wrote down some stuff, but you had a Kardex just right there, so you didnt– I took notes, but I didn't take notes– I didn't have to write down as much. And when the Kardex went, all that information had to go somewhere.

Paper brains provide a nursing-specific space to store constructed knowledge central to nursing practice that is not currently available in formal documentation.

4.5 Brains Are Living Objects

During field observations, after hearing an explanation of the topic of this study, a clinical instructor with students on the unit declared, "[Paper brains] are like living things. They aren't just pieces of paper with information on it." Indeed, like living things, nurses' brains go through a life cycle each shift, and an individual design can evolve over the course of a nurse's career.

4.5.1 Life Cycle of a Brain

The term life cycle is defined as the series of changes in a biological organism, including birth, middle age, reproduction, and death of a living entity. Nurses' brains, like living organisms, go through a similar series of phases. Birth occurs with the creation of a new brain at the beginning of the shift; middle age is the use of the brain during the shift; death occurs with the destruction of a brain when it is deemed no longer useful. Reproduction can be seen as the transfer of information by the nurse from an old brain to a new one. A theoretical representation of the life cycle of a brain can be seen in Figure 4.9.

Brain creation occurs while a nurse prepares a brain for use during the shift. This happens before, during, and after receiving handoff at the beginning of a shift. Nurses will begin with an initial version of their personal brain. This may be a blank sheet of paper for a free-form brain, an empty skeleton, or a printed Nursing Summary Report depending on the nurse's preference. Information about the patients to be under their care is gathered from multiple sources, synthesized, and transferred to the new brain. Creation is complete when a nurse feels in possession of enough information to begin patient care. Rarely did this

occur immediately after report was finished. Most often nurses would continue to review patient charts after the previous nurse(s) had left for the day. Nurses would try to finish the process of brain creation before moving on to patient care; however, this was not always possible. In most cases, when tasks were required to be done before a nurse's brain was complete, the nurse leaving shift or the charge nurse would try to take care of any immediate patient needs. This allowed the oncoming nurse to finish creating the brain before moving on to patient care.

The next phase in a brain's life cycle is "use." This is the process of utilizing a paper brain during a shift and is the middle of the process. Use begins after a nurse completes creating a brain and begins actively caring for patients, and use ends when the nurse determines the brain is no longer needed. This end point varies among nurses, ranging from immediately following giving report at the end of a shift, to a couple weeks or months following the shift. Nurses, especially those who favored a free-form or skeleton brain, reported storing their brains for future reference. The process of synthesizing patient information into a coherent whole is time consuming, and nurses expressed a desire to not repeat the process once it had been done. Old brains are kept beyond the primary shift so information previously synthesized, especially prior medical history, psychosocial concerns, and patient preferences, can be reused on subsequent shifts. The process of transferring information from an old brain to a new brain during creation is analogous to reproduction in the biological life cycle. Old brains are stored in the nurses' individual lockers until they are deemed no longer needed and destroyed. Nurses were more likely to hold on to a brain if they were scheduled to work the next several days in a row because they would likely be assigned to the same patients.

During the use phase, the brain's purpose is mainly as a cognitive artifact—providing a place to organize and prioritize tasks, to store information for retrieval at a glance, and to store general information like telephone numbers for quick reference during the shift. The brain also acts as a storage space for the nurse's constructed "story of the patient" and is the main source of information for handoff to the next nursing shift. During shadowing observations, nurses were observed using their brains to store information "on the fly." Vital signs reported from CNAs, intake and output values for future charting, observations for communication to others, and results of tests and procedures were all jotted down on paper brains for future retrieval by the nurse. Information retrieval occurred while the nurse was charting, or in communication with another person. Communication occurred with other providers, patients, and patients' families. A major part of the use phase is

priority setting and organization. Nurses used their brains to keep track of pending and completed tasks. New tasks would be hand-written on each brain as the shift continued. In addition, brains were used as scratch paper to make calculations, take personal notes like book recommendations, and for doodling. Doodling most often occurred while the nurse was waiting either to give handoff or for a time-sensitive task due within minutes; however, in one case, Violet used her brain to sketch a chemotherapy intravenous infusion device (see Figure 4.10). Violet used this sketch as an education tool to demonstrate proper taping technique to a novice nurse.

Beyond cognitive support, paper brains may also provide a subtle sense of safety or security for nurses. All nurses spoke of feeling safer knowing that if the electronic medical record went down, they had the information they needed to care for patients with them in a "crash-proof" format. Frustration with the unreliability of electronic formats was a frequent occurrence on the unit and mentioned in multiple interviews. In every shadowing observation, a nurse would experience problems with logging into the EHR at least once during the shift. Difficulties with the printers for the newly implemented barcode medication administration system were also observed, though the frequency of these problems decreased with time after implementation.

The final phase in a brain's life cycle is destruction. Destruction is the process of destroying the brain after it is deemed no longer useful. As mentioned above, destruction can occur immediately following a shift, or several weeks after. For nurses using the Nursing Summary Report, destruction occurred immediately following a shift. These nurses would place their brains in "the shredder"—a locked box used to store sensitive documents for later shredding in bulk—as they left the unit at the end of their shift. Nurses who stored old brains in their lockers reported destroying their brains either after the last shift in a series of consecutive shifts, or when they cleaned out their locker.

Paper brains are most often destroyed by the person who owns them; however, it is acceptable for others to destroy a brain if it is determined to be abandoned by its owner. This occurred twice during field observations. In the first instance, the Health Unit Coordinator (HUC) was tidying up the nurses station after handoff had been completed. He was gathering up stray papers to be thrown away or shredded. One of the papers was a nurse's brain left next to a computer workstation. He unfolded it, looked at both sides, and looked from the patient board to the paper brain. He said to himself, "This is old," and put it in the shredder box. When asked how he knew it was old, he explained he checked the patient names against the patient board. One patient listed on the brain had been

discharged the day before, so it was safe to assume the brain was no longer needed by its owner. In the other observed instance, a nurse found an abandoned brain while charting at a computer in the nurses' station. She said, "Oh, this is Jane's. She's gone home," and put the paper brain in the shredder. This nurse explained she had received handoff report from Jane for one of the patients listed on the brain at the beginning of the shift. She recognized the owner of the brain through the patient name, not by recognizing the brain itself as belonging to Jane. In interviews, nurses described discovering the owner of an abandoned brain most often via patient names, though some brains were recognizable by their design for nurses they frequently worked with.

4.5.2 Evolution of a Brain

Just as nurses' brains exhibit life cycles, they also undergo processes similar to evolution in biological organisms. Evolution is the process living organisms go through to develop and diversify into different species. Nurses' brains can be viewed to experience their own evolutionary process. Evolution in a paper brain is triggered by a change in the nurse's environment that reshapes their cognitive needs. If a paper brain is not able to provide cognitive support in the new environment, it is modified into (adaptation), or abandoned for (extinction), a different format that will provide the necessary support. In such a case, with each new nursing shift and brain life cycle, a nurse may either abandon or modify the paper brain until a new design solidifies that is "good enough" for the nurse's cognitive needs, but not necessarily perfect. Three types of change events that brought about evolution for the nurses in this study are described below.

4.5.2.1 A nurse's first brain

The evolution of nurses' brains begins with a nurse's first brain. For 10 of the nurses in this study, their first brain was given to them when they started clinical practica in nursing school. None of the nurses received didactic training on how to create a brain. Nurses gained knowledge of how to make and use a brain during clinical experience as a student or on the first job after graduation. Students frequently used the same brain format as their preceptor, using a new brain design with each different preceptor encountered, until a format "clicked with them." This final format would then be tweaked to address any design aspects that did not work for them individually. Font, location of groupings of data, and spacing so that more patients would fit on a page were examples of modified aspects. Every nurse in the study expressed a willingness to share their brain design with other nurses and students.

Lucy, a nurse with less than 1 year of experience, used three different brains during field observations: the Nursing Summary Report, a one-patient-per-page skeleton developed for the Bone Marrow Transplant unit, and a modified version of Olivia's skeleton brain.

> **Lucy:** So I am a new nurse. I just graduated last May, and I've only been here... almost a year. So I've gone through several different report sheets, like brains, to find out what works best for me. I did this one off of [Olivia], because she has one very similar. Hers is different in that she doesn't have this area. But there's things that I still feel like I need to change.

Figures 4.11 and 4.12 show the differences Lucy made to Olivia's brain to make it her own.

Preceptors would help students in the development of their brains by describing what information was important to include in a brain, but stressed that the format had to work for the individual. During one field observation before handoff began, a nurse preceptor explained to a student that the specific format of her brain did not matter, as long as the student was able to find needed information. As she explained this, the preceptor made a gesture moving her open hands from her temples to the page, as if she was lifting something out of her head and transferring it to the page. The preceptor offered the student a copy of her brain to use for the shift, but this student declined because she had a form she had been using for over a semester provided by her previous clinical instructor. Mary, a nurse with over 10 years of experience, explained during her interview how she taught students about brains:

> **Mary:** I will say, "this is how I do it." I don't care how you write it down but when we leave here... before we walk into a patient's room, [I want you to] be able to tell me why they're there, what we're worried about, what their labs are, and what their clinical status is, who we're going to call and why we're worried about it, or why we're going to call them. ... And then I'm probably going to look at what they've written down and I'm going to let them work with it a little bit... I'm going to see what they add throughout the day... It would be one of the first things we worked on, but it would be over the course of several days to say, "Okay I see that you got this, so you didn't get this or you have all of this; you may not need that; we're getting more bogged down in that."

Two of the nurses spoke of "just figuring out" how to make their first brain. Both discussed having a feeling of being lost or overwhelmed on their first day during handoff. Zoe mentioned, "I just kind of looked over other people's shoulders and saw how they— and took a little bit from here, little bit from there, and just developed it myself." Gretchen explained that her brain is an abridged form of the reports she had to write in nursing school for her clinical experience. The report was around 12 pages long—each page covering a different clinical topic. Each section of her brain now corresponds with a section in the

student report. She said that if the instructor wanted to know specific information, it was probably important to know, so she writes it down on her brain.

4.5.2.2 A change in the system

System changes—a change in focus from team to individual nursing, the implementation of a new EHR, or a move to bedside handoff, for example—can trigger the evolution of a nurse's brain. When a system change occurs, cognitive needs will likely change. Thus aspects of a cognitive artifact would change to provide support for those needs. Minor adjustments to the previous brain may be enough for the nurse to adapt to the new situation, or the previous brain may need to be abandoned completely. Zoe discussed how her brain changed when the hospital she was working for moved from a team-based approach to an individual approach to nursing:

> **Interviewer:** And has [your brain] always looked like this?
> **Zoe:** No. When I used to do team leading, it was on lined paper, not on white paper. And I would actually make lines going up and down the paper to create different areas like where I would keep track of intake and output and then separate out where the IV information went and separate out. It was a little more structured.

For Zoe, the evolution of her brain was not a difficult process. In contrast, Mary was in the process of moving from a free-form brain that she had been using for several years to the administration-supported Nursing Summary Report at the time of her observation. For this nurse, the transition was not going well.

> **Mary:** So I've been printing out a summary report for the last, probably three weeks, somewhat regularly. I don't do it every day. But I noticed while I was floating [to other units], that everybody uses these, and that sometimes they have them preprinted for us when we get there, and that. So I watched what some other nurses were doing and I noticed how they were filling in the information, and I thought, well I can try that. But I do not find that, in general, it leaves me ample room to get patients' back story, more details about what they need for their chemo, details about treatment. It's difficult when you start really writing in a lot of stuff, to see, if somebody's neutropenic, it's difficult to see when their last blood cultures were and what they're doing... So I'm trying to use this and... and to say, okay, when I float, I can use this to organize, but it really just means more paper that I carry around and more places that I have to look for stuff... I don't have plans to do this– I mean, I'm going to try it for probably another week or so, and then I won't do it unless I float, I think.

4.5.2.3 A new job

Sometimes the change that triggers evolution of a brain is a move to a new environment all together. A brain must be able to support the nurse in their new environment. Nurses

who had come to this unit from another hospital spoke about only needing to update their brains from their previous jobs to include information specific for medical oncology patients. Violet pointed out that she now writes down information related to chemotherapy, such as protocol, cycle number, and treatment day, in a space on her brain designated for just diagnosis when she worked on a different unit.

Felix was particularly unique in his readiness to adopt a new form when hired on a unit. When asked how he learned to make a brain, he responded, "I don't know how to make a brain." When pressed further, he explained that he was always given a brain to use when starting at a new unit.

> **Interviewer:** How did you learn to make a brain?
> **Felix:** This one was given to me. Actually, I don't know how to make a brain. [Another hospital where I worked before] gave me one and this one was given to me when I started here. I don't know. It's all based on what more experienced nurses have given me... I wish I was motivated enough to go home and make one. Usually I want to eat dinner and go to bed.

His openness to new designs may be related to changing jobs, in that the change in environment leads to a dramatic change in workflow, making the nurse more open to a new system. Or, this openness may be an indicator of his relatively little experience as a nurse as was seen in Lucy, a nurse with less than a year experience. She expressed a similar openness to different brain formats. At the time of her interview, she felt the brain she was currently using would be the one she kept, but explained that she would be willing to change it, if she had to or if she found something better.

> **Lucy:** I have absolutely no emotional connection to this piece of paper. [chuckles]
> **Interviewer:** No emotional connection. Okay. That's interesting.
> **Lucy:** No. I don't. It is what it is. And if someone showed me something better, I would drop this thing in a heartbeat. It doesn't matter. It doesn't. So. But again, I'm still learning, and I'm still learning what's best for me. So. Maybe when I'm— like 20 years from now I'll be like, "Don't you talk about my brain!"

This exchange was in stark contrast to more experienced nurses who would make comments in passing such as, "Please don't take my brain away," and "Don't take my brain. I'll have to retire."

4.5.3 It's Good Enough: Stabilization After Evolution

After any process of brain evolution, the design would eventually stabilize into a format that was considered "good enough" by the nurse using it. Olivia said, "There's things I would change [about my brain]. This isn't perfect, but it's good enough. It works for

me." This type of stabilization was most apparent in the skeleton brains. All but 1 of the nurses using a skeleton format expressed a similar sentiment, mentioning small things they wanted to change about their brains, but had not yet done so. Making the space designated for medical history and assessment larger, deleting an area designated for intake and output they no longer used, and adding or removing labels were all given as examples of desired changes. Electronic copies of blank skeletons, if they existed, were stored on home computers, not at the hospital, and were less of a priority once arriving home. Olivia mentioned that her template was created in a version of Microsoft Office that was out of date, so she was unable to access it for editing. Felix and Gretchen had only a paper-based version of their skeleton and would have to re-create it in electronic format to make any changes. This was seen as an unnecessary burden since their brains were viewed as "good enough."

For people who used a free-form brain, there was less of a barrier for change. These nurses could just instantly make the change while receiving handoff at the beginning of a shift. For example, Mary explained that she had added a box around IV access information "at some point so that it would pop out at [her] more," because she wanted to be able to see that information more quickly. However, at least one free-form brain showed signs of solidification. Figure 4.13 of Zoe's brain shows labels for intakes and outputs to be recorded, but these items of data were actually jotted down elsewhere on the page. Though they were no longer actually useful for her, she continued to write the labels on her brain for every patient.

Nurses using the Nursing Summary Report exhibited solidification differently because they could not change what information included in the printout, and the printout itself was fairly dynamic. Though each predefined section of the Nursing Summary Report would print in the same area, certain sections—particularly orders and labs—could vary greatly in size based on the amount of information stored for each patient. Data could be truncated, or left off completely, and specific orders would be in different locations within the section across patients. Figures 4.14 and 4.15 show Nursing Summary Reports for two different patients. In Figure 4.14, the order for diet is printed from the EHR midway down the right-hand column of orders. In Figure 4.15, the diet order is not printed at all. Kiera solved this variability by rewriting the diet order at the top middle of the page (Figure 4.14). She did this for all her patients. Mary wrote in the diet order at the location closest to where it would print if there had been room (Figure 4.15), but would highlight the diet order for her other patients. Also seen in these figures, the amount of free space for

additional note-taking could vary greatly across reports. This required nurses who used the Nursing Summary Report to be more flexible about where they would write additional information, and how much space they needed to do so. Kiera would consistently write the times medications were due, fishbone diagrams, and pertinent orders in the bottom margin, regardless if there was printed space for notes (see Figure 4.14). In contrast, Collette would fill in labels for the body system for patient assessment for each patient, and would adjust how much room was used based on how much was available. This can be seen by comparing Figure 4.16 to Figure 4.17.

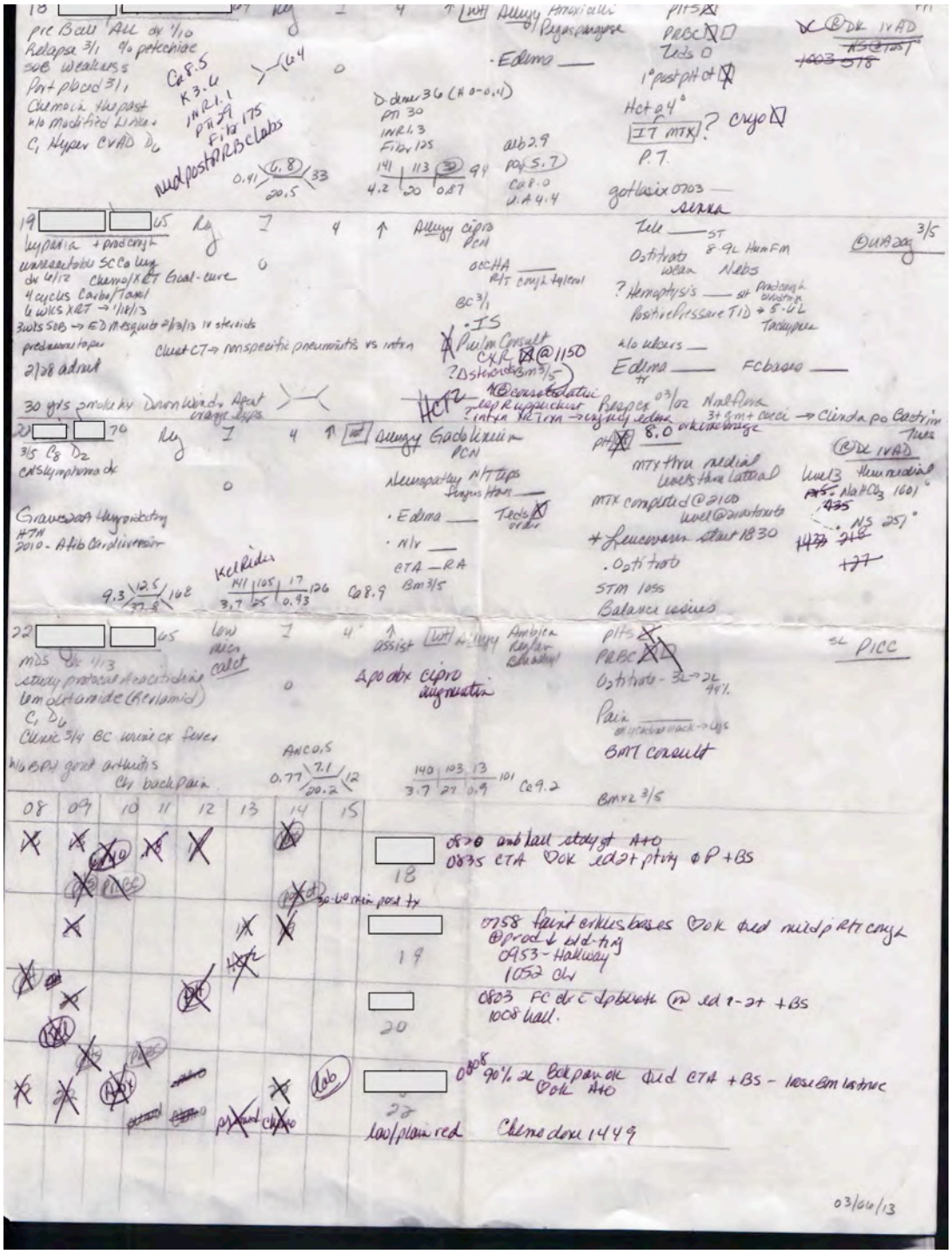


Figure 4.1. A Free-Form Brain Made by Zoe.

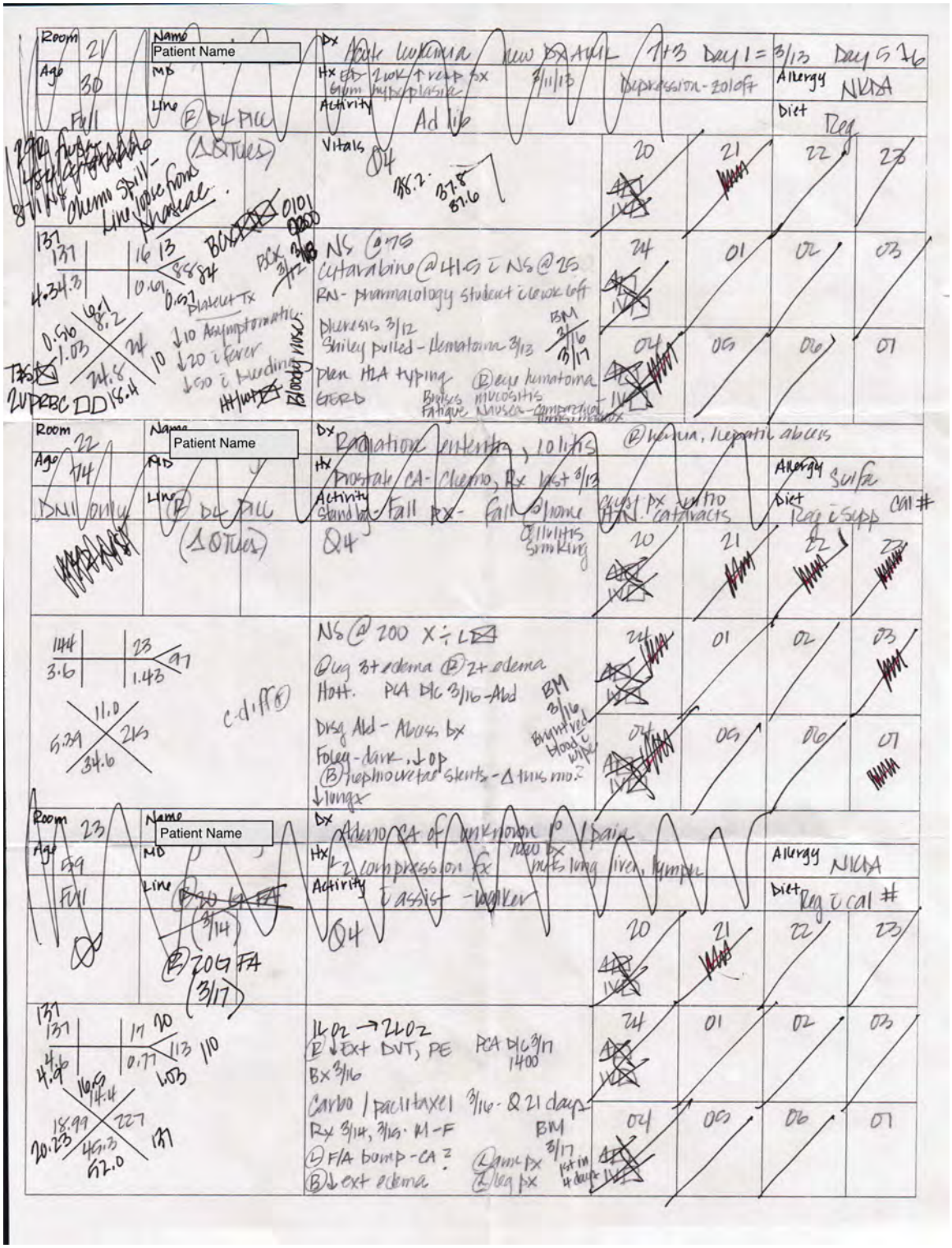
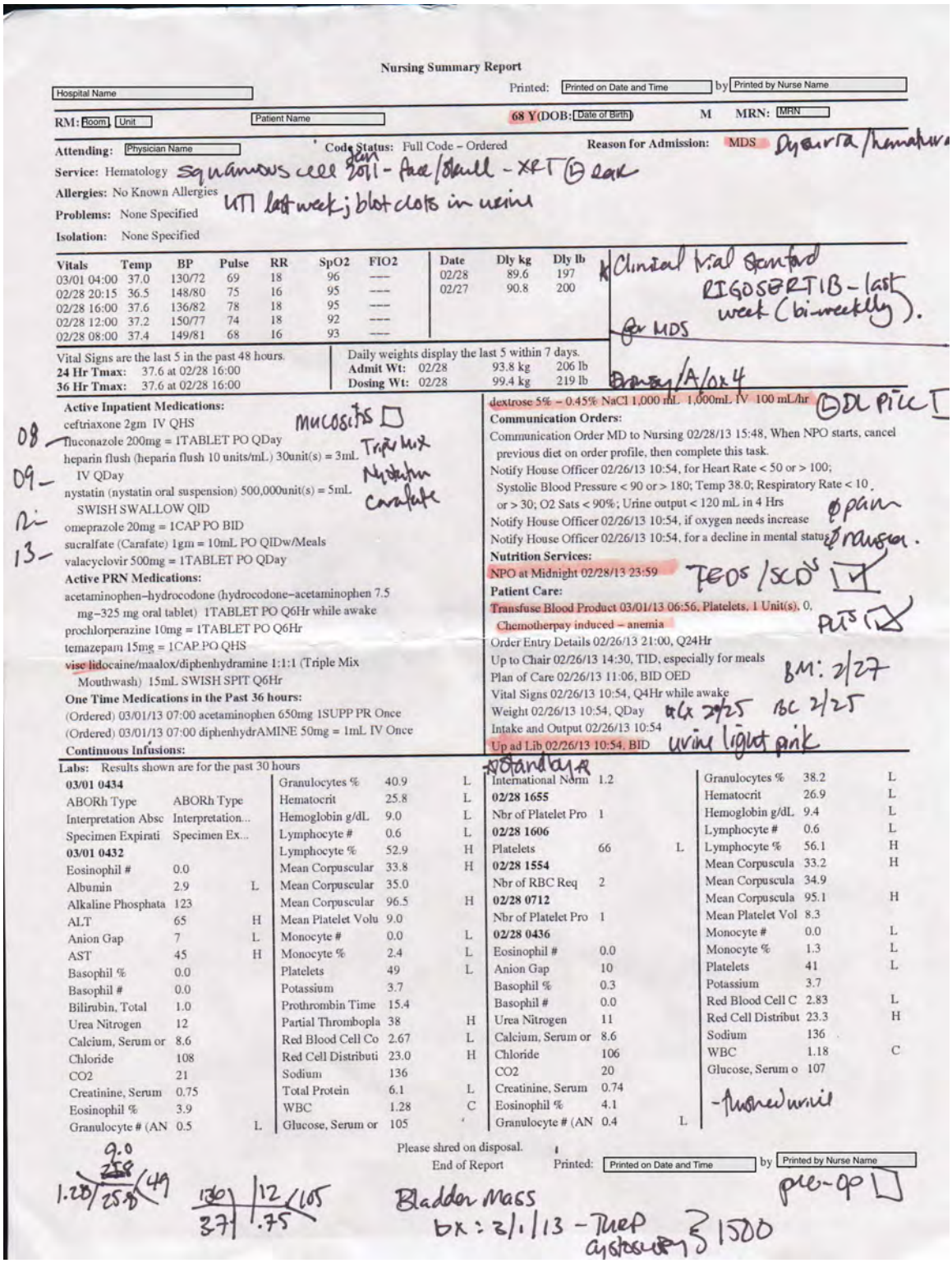


Figure 4.2. An Example of a Skeleton Brain.



Nursing Summary Report

Hospital Name — Printed: Printed on Date and Time by Printed by Nurse Name

RM: Room Unit — Patient Name — 68 Y (DOB: Date of Birth) M — MRN: MRN

Attending: Physician Name — Code Status: Full Code – Ordered — Reason for Admission: MDS Dysuria/hematur

Service: Hematology squamous cell Jan 2011 - face/skull - XRT (L ear

Allergies: No Known Allergies UTI last week; blot clots in urine

Problems: None Specified

Isolation: None Specified

Vitals	Temp	BP	Pulse	RR	SpO2	FIO2
03/01 04:00	37.0	130/72	69	18	96	---
02/28 20:15	36.5	148/80	75	16	95	---
02/28 16:00	37.6	136/82	78	18	95	---
02/28 12:00	37.2	150/77	74	18	92	---
02/28 08:00	37.4	149/81	68	16	93	---

Date	Dly kg	Dly lb
02/28	89.6	197
02/27	90.8	200

Clinical trial Stanford RIGOSERTIB - last week (bi-weekly). for MDS

Vital Signs are the last 5 in the past 48 hours.
24 Hr Tmax: 37.6 at 02/28 16:00
36 Hr Tmax: 37.6 at 02/28 16:00

Daily weights display the last 5 within 7 days.
Admit Wt: 02/28 93.8 kg 206 lb
Dosing Wt: 02/28 99.4 kg 219 lb

Bruising/A/ox4

Active Inpatient Medications:
ceftriazone 2gm IV QHS
fluconazole 200mg = 1TABLET PO QDay
heparin flush (heparin flush 10 units/mL) 30unit(s) = 3mL IV QDay
nystatin (nystatin oral suspension) 500,000unit(s) = 5mL SWISH SWALLOW QID
omeprazole 20mg = 1CAP PO BID
sucralfate (Carafate) 1gm = 10mL PO QIDw/Meals
valacyclovir 500mg = 1TABLET PO QDay

mucositis Triple Mix Nystatin Carafate

08 09 13

Active PRN Medications:
acetaminophen–hydrocodone (hydrocodone–acetaminophen 7.5 mg–325 mg oral tablet) 1TABLET PO Q6Hr while awake
prochlorperazine 10mg = 1TABLET PO Q6Hr
temazepam 15mg = 1CAP PO QHS
vise lidocaine/maalox/diphenhydramine 1:1:1 (Triple Mix Mouthwash) 15mL SWISH SPIT Q6Hr

One Time Medications in the Past 36 hours:
(Ordered) 03/01/13 07:00 acetaminophen 650mg 1SUPP PR Once
(Ordered) 03/01/13 07:00 diphenhydrAMINE 50mg = 1mL IV Once

Continuous Infusions:
dextrose 5% – 0.45% NaCl 1,000 mL 1,000mL IV 100 mL/hr

(L PICC

Communication Orders:
Communication Order MD to Nursing 02/28/13 15:48, When NPO starts, cancel previous diet on order profile, then complete this task.
Notify House Officer 02/26/13 10:54, for Heart Rate < 50 or > 100; Systolic Blood Pressure < 90 or > 180; Temp 38.0; Respiratory Rate < 10 or > 30; O2 Sats < 90%; Urine output < 120 mL in 4 Hrs
Notify House Officer 02/26/13 10:54, if oxygen needs increase
Notify House Officer 02/26/13 10:54, for a decline in mental status

@ pain @ nausea.

Nutrition Services:
NPO at Midnight 02/28/13 23:59

Patient Care:
Transfuse Blood Product 03/01/13 06:56, Platelets, 1 Unit(s), 0, Chemotherapy induced – anemia
Order Entry Details 02/26/13 21:00, Q24Hr
Up to Chair 02/26/13 14:30, TID, especially for meals
Plan of Care 02/26/13 11:06, BID OED
Vital Signs 02/26/13 10:54, Q4Hr while awake
Weight 02/26/13 10:54, QDay
Intake and Output 02/26/13 10:54
Up ad Lib 02/26/13 10:54, BID

TEDs/SCDs IV

PLTS

BM: 2/27

H&H 2/25 BC 2/25

urine light pink

standing

Labs: Results shown are for the past 30 hours

03/01 0434			Granulocytes %	40.9	L	International Norm	1.2		Granulocytes %	38.2	L
ABORh Type	ABORh Type		Hematocrit	25.8	L	**02/28 1655**			Hematocrit	26.9	L
Interpretation Absc	Interpretation...		Hemoglobin g/dL	9.0	L	Nbr of Platelet Pro	1		Hemoglobin g/dL	9.4	L
Specimen Expirati	Specimen Ex...		Lymphocyte #	0.6	L	**02/28 1606**			Lymphocyte #	0.6	L
03/01 0432			Lymphocyte %	52.9	H	Platelets	66	L	Lymphocyte %	56.1	H
Eosinophil #	0.0		Mean Corpuscular	33.8	H	**02/28 1554**			Mean Corpuscula	33.2	H
Albumin	2.9	L	Mean Corpuscular	35.0		Nbr of RBC Req	2		Mean Corpuscula	34.9	
Alkaline Phosphata	123		Mean Corpuscular	96.5	H	**02/28 0712**			Mean Corpuscula	95.1	H
ALT	65	H	Mean Platelet Volu	9.0		Nbr of Platelet Pro	1		Mean Platelet Vol	8.3	
Anion Gap	7	L	Monocyte #	0.0	L	**02/28 0436**			Monocyte #	0.0	L
AST	45	H	Monocyte %	2.4	L	Eosinophil #	0.0		Monocyte %	1.3	L
Basophil %	0.0		Platelets	49	L	Anion Gap	10		Platelets	41	L
Basophil #	0.0		Potassium	3.7		Basophil %	0.3		Potassium	3.7	
Bilirubin, Total	1.0		Prothrombin Time	15.4		Basophil #	0.0		Red Blood Cell C	2.83	L
Urea Nitrogen	12		Partial Thrombopla	38	H	Urea Nitrogen	11		Red Cell Distribut	23.3	H
Calcium, Serum or	8.6		Red Blood Cell Co	2.67	L	Calcium, Serum or	8.6		Sodium	136	
Chloride	108		Red Cell Distributi	23.0	H	Chloride	106		WBC	1.18	C
CO2	21		Sodium	136		CO2	20		Glucose, Serum o	107	
Creatinine, Serum	0.75		Total Protein	6.1	L	Creatinine, Serum	0.74				
Eosinophil %	3.9		WBC	1.28	C	Eosinophil %	4.1				
Granulocyte # (AN	0.5	L	Glucose, Serum or	105		Granulocyte # (AN	0.4	L			

-transfusion

Please shred on disposal.
End of Report

Printed: Printed on Date and Time by Printed by Nurse Name

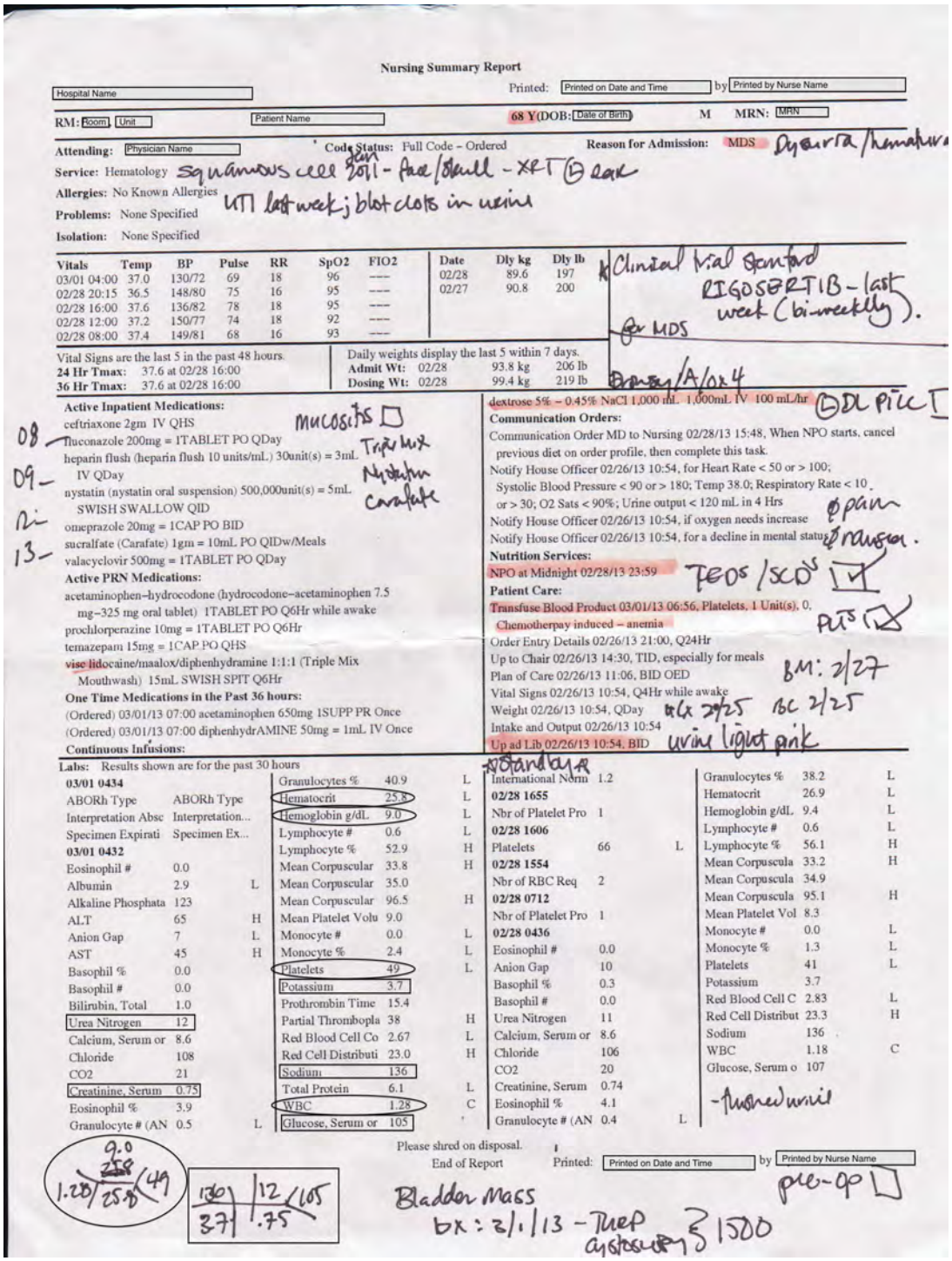
9.0 / 25.8 / 49 / 1.28

130 / 12 / 105 / 37 / .75

Bladder mass
Bx: 2/1/13 - TURP cystoscopy 1500

pre-op

Figure 4.3. An Example of a Nursing Summary Report



Nursing Summary Report

Hospital Name | Printed: Printed on Date and Time by Printed by Nurse Name

RM: Room Unit | Patient Name | 68 Y (DOB: Date of Birth) M MRN: MRN

Attending: Physician Name | Code Status: Full Code – Ordered | Reason for Admission: MDS

Service: Hematology

Allergies: No Known Allergies

Problems: None Specified

Isolation: None Specified

Vitals	Temp	BP	Pulse	RR	SpO2	FIO2
03/01 04:00	37.0	130/72	69	18	96	---
02/28 20:15	36.5	148/80	75	16	95	---
02/28 16:00	37.6	136/82	78	18	95	---
02/28 12:00	37.2	150/77	74	18	92	---
02/28 08:00	37.4	149/81	68	16	93	---

Vital Signs are the last 5 in the past 48 hours.
24 Hr Tmax: 37.6 at 02/28 16:00
36 Hr Tmax: 37.6 at 02/28 16:00

Date	Dly kg	Dly lb
02/28	89.6	197
02/27	90.8	200

Daily weights display the last 5 within 7 days.
Admit Wt: 02/28 93.8 kg 206 lb
Dosing Wt: 02/28 99.4 kg 219 lb

Active Inpatient Medications:
ceftriaxone 2gm IV QHS
fluconazole 200mg = 1TABLET PO QDay
heparin flush (heparin flush 10 units/mL) 30unit(s) = 3mL IV QDay
nystatin (nystatin oral suspension) 500,000unit(s) = 5mL SWISH SWALLOW QID
omeprazole 20mg = 1CAP PO BID
sucralfate (Carafate) 1gm = 10mL PO QIDw/Meals
valacyclovir 500mg = 1TABLET PO QDay

Active PRN Medications:
acetaminophen–hydrocodone (hydrocodone–acetaminophen 7.5 mg–325 mg oral tablet) 1TABLET PO Q6Hr while awake
prochlorperazine 10mg = 1TABLET PO Q6Hr
temazepam 15mg = 1CAP PO QHS
vise lidocaine/maalox/diphenhydramine 1:1:1 (Triple Mix Mouthwash) 15mL SWISH SPIT Q6Hr

One Time Medications in the Past 36 hours:
(Ordered) 03/01/13 07:00 acetaminophen 650mg 1SUPP PR Once
(Ordered) 03/01/13 07:00 diphenhydrAMINE 50mg = 1mL IV Once

Continuous Infusions:
dextrose 5% – 0.45% NaCl 1,000 mL 1,000mL IV 100 mL/hr

Communication Orders:
Communication Order MD to Nursing 02/28/13 15:48, When NPO starts, cancel previous diet on order profile, then complete this task.
Notify House Officer 02/26/13 10:54, for Heart Rate < 50 or > 100; Systolic Blood Pressure < 90 or > 180; Temp 38.0; Respiratory Rate < 10 or > 30; O2 Sats < 90%; Urine output < 120 mL in 4 Hrs
Notify House Officer 02/26/13 10:54, if oxygen needs increase
Notify House Officer 02/26/13 10:54, for a decline in mental status

Nutrition Services:
NPO at Midnight 02/28/13 23:59

Patient Care:
Transfuse Blood Product 03/01/13 06:56, Platelets, 1 Unit(s), 0, Chemotherapy induced – anemia
Order Entry Details 02/26/13 21:00, Q24Hr
Up to Chair 02/26/13 14:30, TID, especially for meals
Plan of Care 02/26/13 11:06, BID OED
Vital Signs 02/26/13 10:54, Q4Hr while awake
Weight 02/26/13 10:54, QDay
Intake and Output 02/26/13 10:54
Up ad Lib 02/26/13 10:54, BID

Labs: Results shown are for the past 30 hours

03/01 0434			Granulocytes %	40.9	L	International Norm	1.2		Granulocytes %	38.2	L
ABORh Type	ABORh Type		Hematocrit	25.8	L	**02/28 1655**			Hematocrit	26.9	L
Interpretation Absc	Interpretation...		Hemoglobin g/dL	9.0	L	Nbr of Platelet Pro	1		Hemoglobin g/dL	9.4	L
Specimen Expirati	Specimen Ex...		Lymphocyte #	0.6	L	**02/28 1606**			Lymphocyte #	0.6	L
03/01 0432			Lymphocyte %	52.9	H	Platelets	66	L	Lymphocyte %	56.1	H
Eosinophil #	0.0		Mean Corpuscular	33.8	H	**02/28 1554**			Mean Corpuscula	33.2	H
Albumin	2.9	L	Mean Corpuscular	35.0		Nbr of RBC Req	2		Mean Corpuscula	34.9	
Alkaline Phosphata	123		Mean Corpuscular	96.5	H	**02/28 0712**			Mean Corpuscula	95.1	H
ALT	65	H	Mean Platelet Volu	9.0		Nbr of Platelet Pro	1		Mean Platelet Vol	8.3	
Anion Gap	7	L	Monocyte #	0.0	L	**02/28 0436**			Monocyte #	0.0	L
AST	45	H	Monocyte %	2.4	L	Eosinophil #	0.0		Monocyte %	1.3	L
Basophil %	0.0		Platelets	49	L	Anion Gap	10		Platelets	41	L
Basophil #	0.0		Potassium	3.7		Basophil %	0.3		Potassium	3.7	
Bilirubin, Total	1.0		Prothrombin Time	15.4		Basophil #	0.0		Red Blood Cell C	2.83	L
Urea Nitrogen	12		Partial Thrombopla	38	H	Urea Nitrogen	11		Red Cell Distribut	23.3	H
Calcium, Serum or	8.6		Red Blood Cell Co	2.67	L	Calcium, Serum or	8.6		Sodium	136	
Chloride	108		Red Cell Distributi	23.0	H	Chloride	106		WBC	1.18	C
CO2	21		Sodium	136		CO2	20		Glucose, Serum o	107	
Creatinine, Serum	0.75		Total Protein	6.1	L	Creatinine, Serum	0.74				
Eosinophil %	3.9		WBC	1.28	C	Eosinophil %	4.1				
Granulocyte # (AN	0.5	L	Glucose, Serum or	105		Granulocyte # (AN	0.4	L			

Please shred on disposal.
End of Report Printed: Printed on Date and Time by Printed by Nurse Name

Figure 4.4. A Nursing Summary Report with a CBC Fishbone Diagram (in the Oval) and a BMP Fishbone Diagram (in the Rectangle) with Corresponding Values Indicated by Shape.

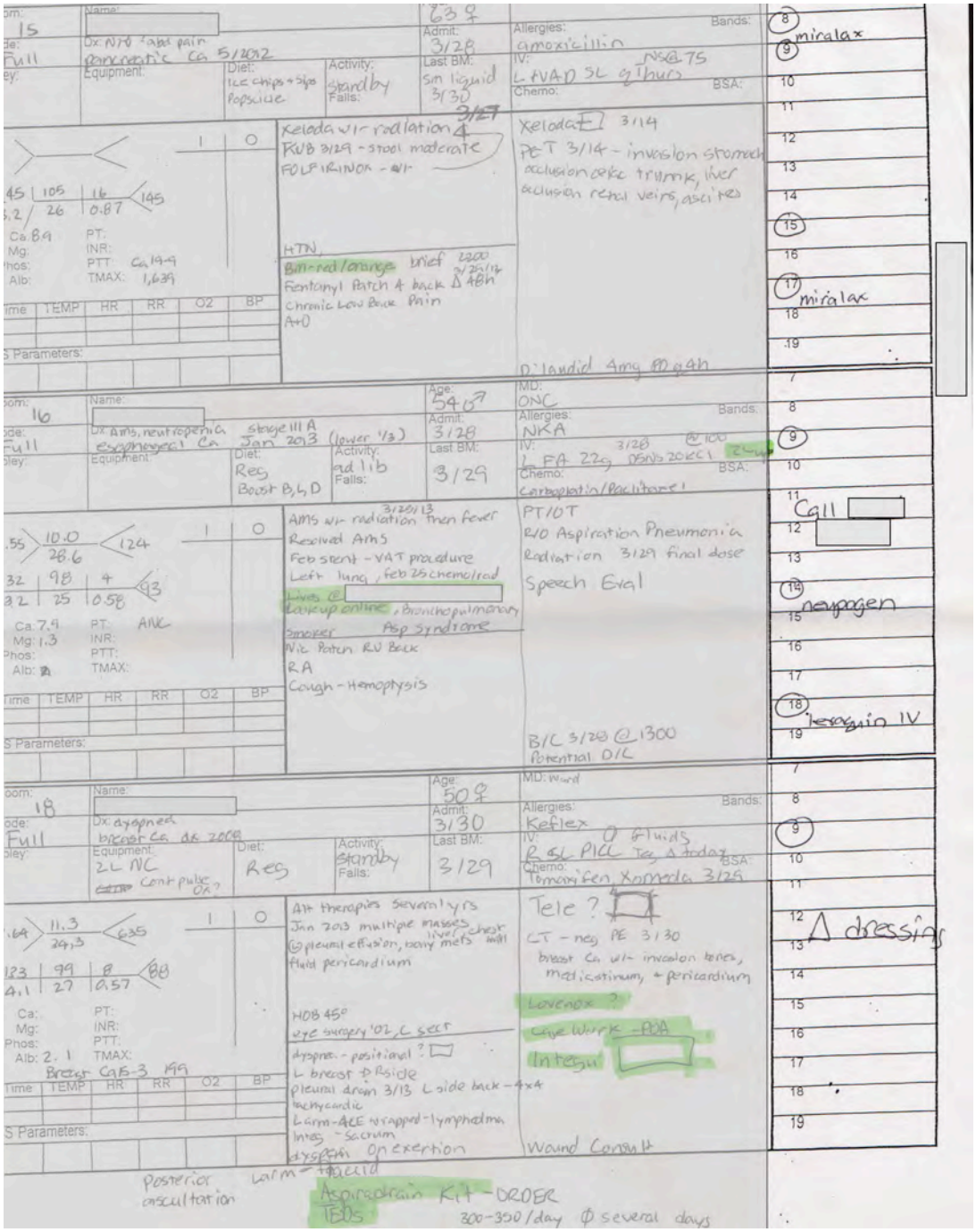


Figure 4.5. Felix's Brain Showing Schedules of Medications and Tasks by Patient and Listing All Hours of the Shift.

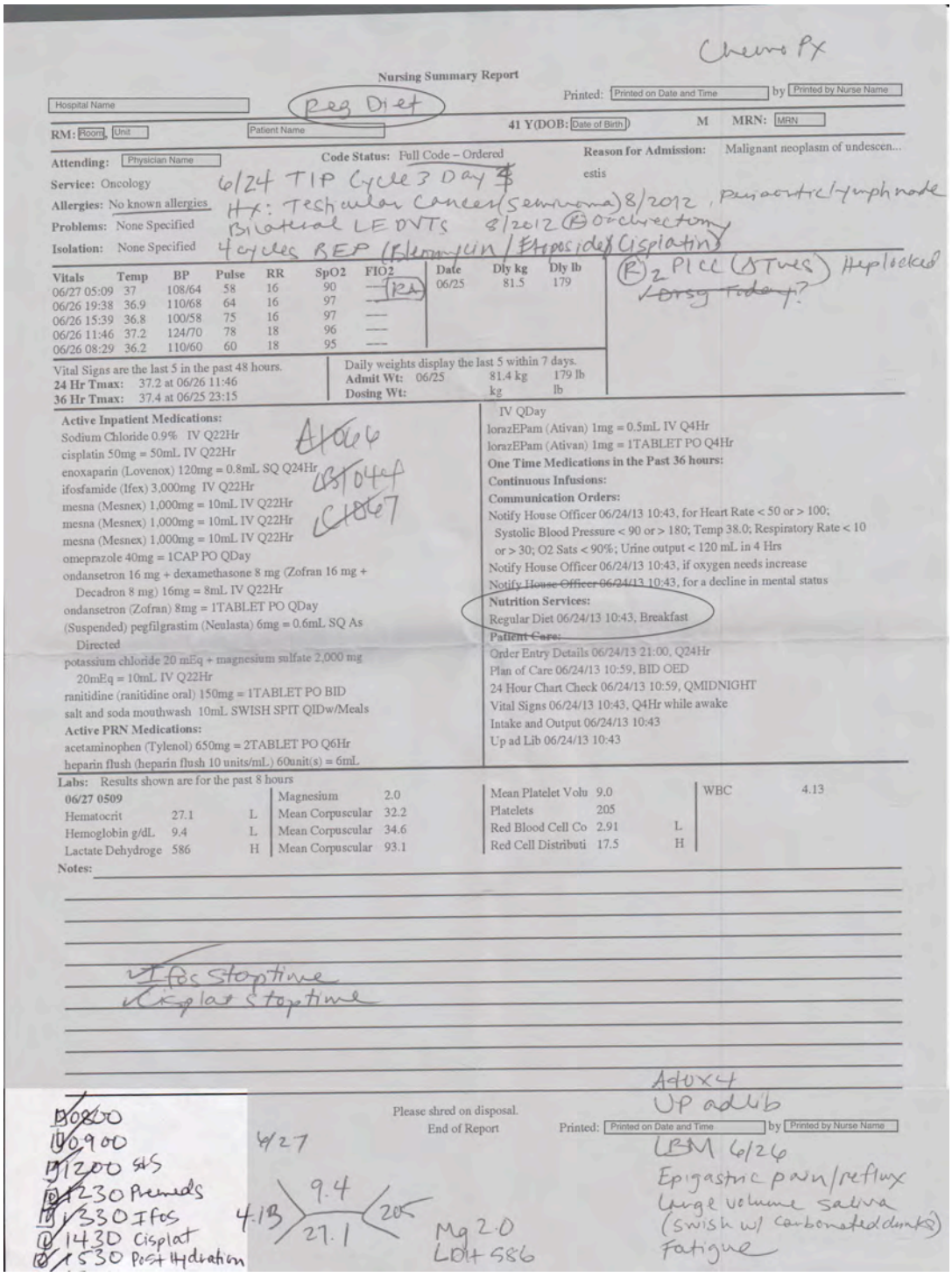


Figure 4.6. Keira's Brain Showing a Schedule of Medications for an Individual Patient and Listing a Subset of Hours of the Shift.

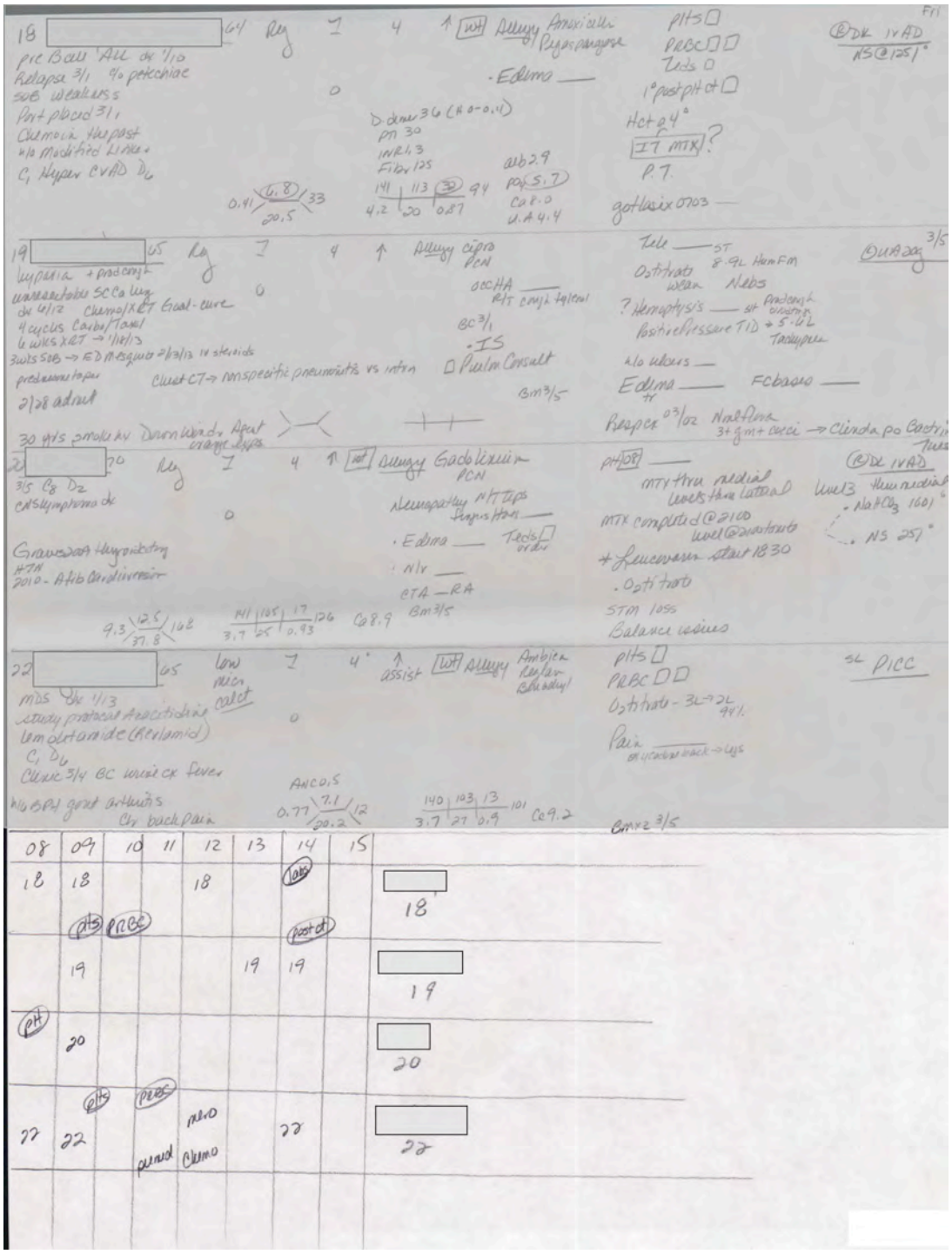


Figure 4.7. Zoe's Brain Showing a Comprehensive Schedule of Medications and Tasks.

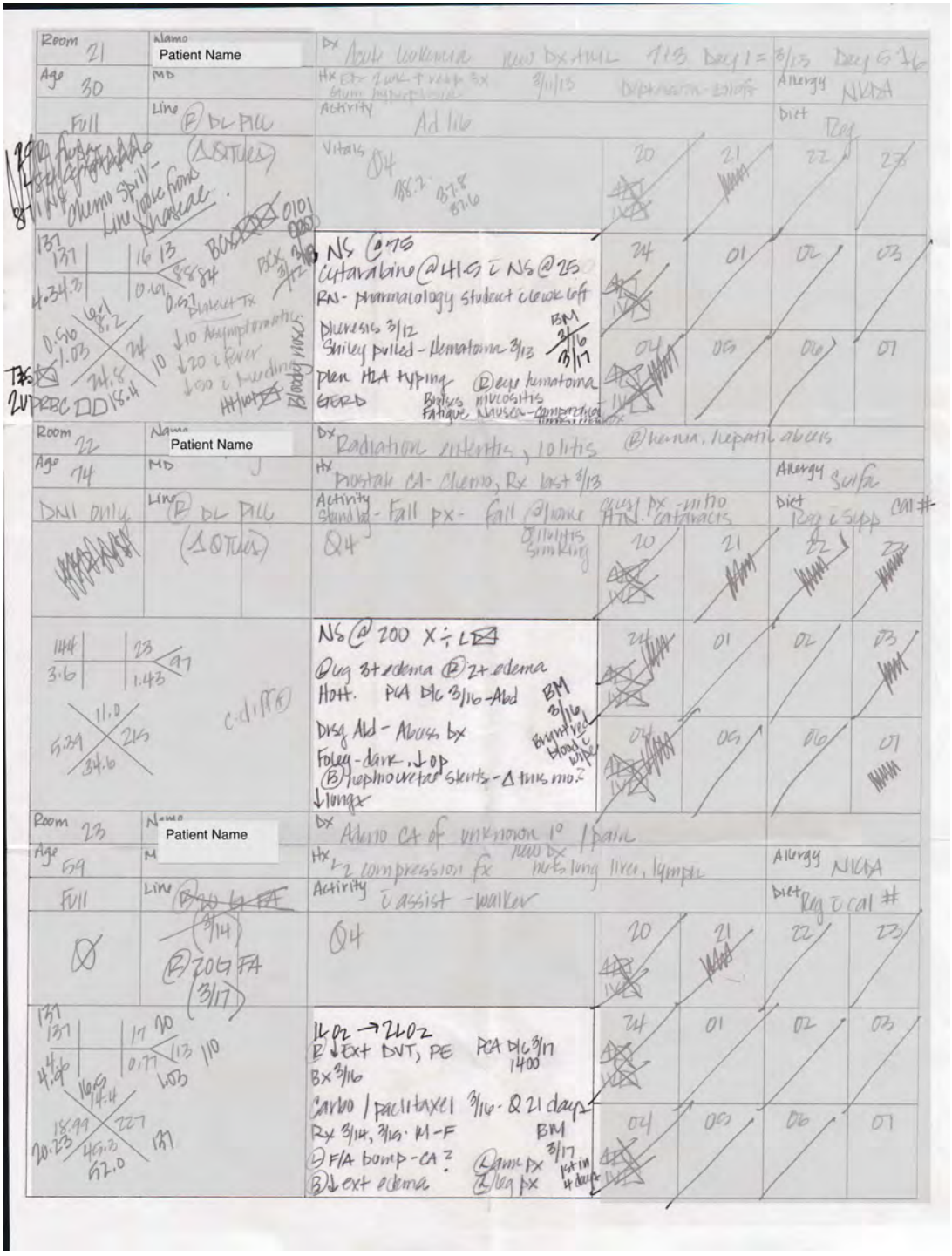


Figure 4.8. Violet's Brain (Front Side) with Patient Story Highlighted.

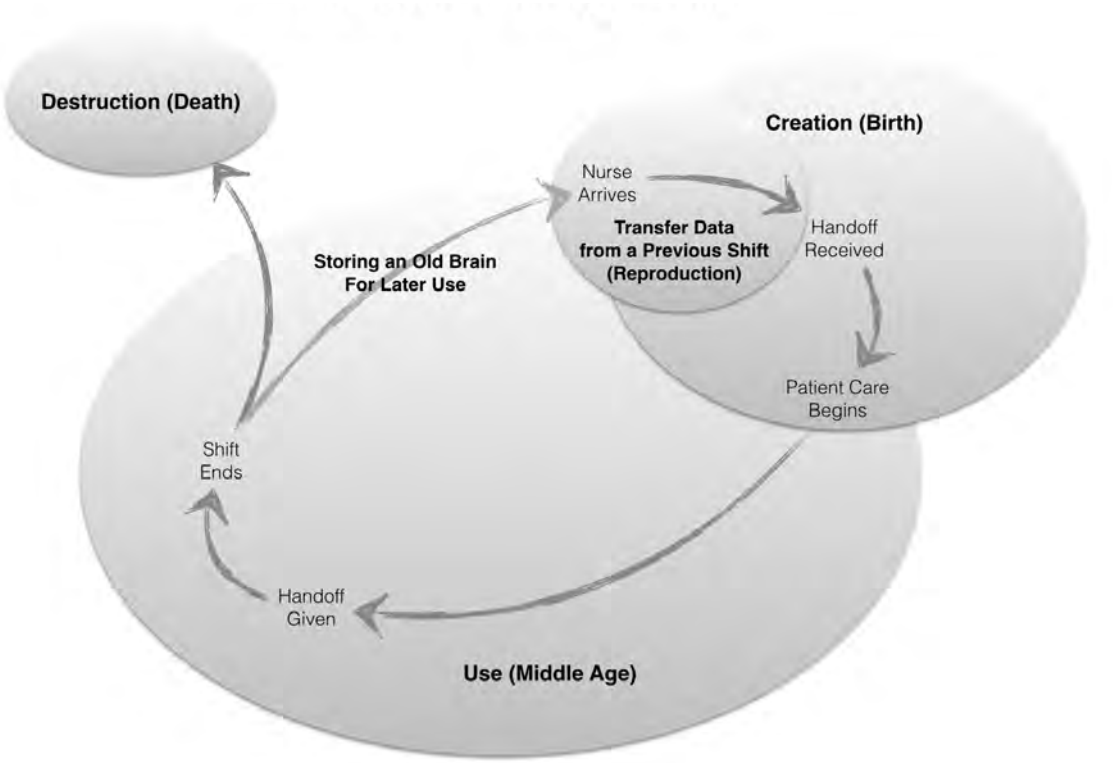


Figure 4.9. The Life Cycle of a Paper Brain.

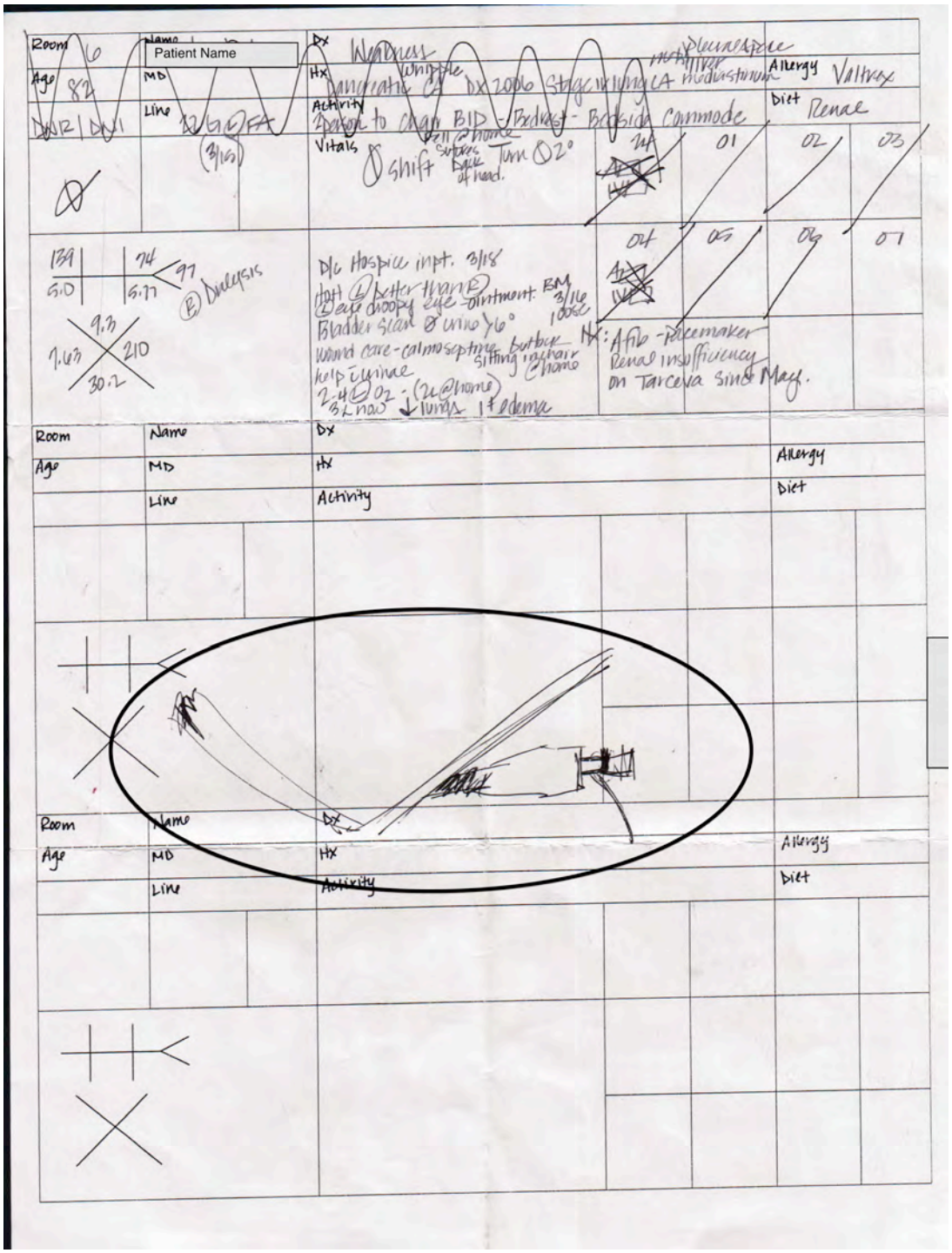


Figure 4.10. Violet's Brain (Back Side) with a Drawing of a Chemotherapy Intravenous Infusion Device.

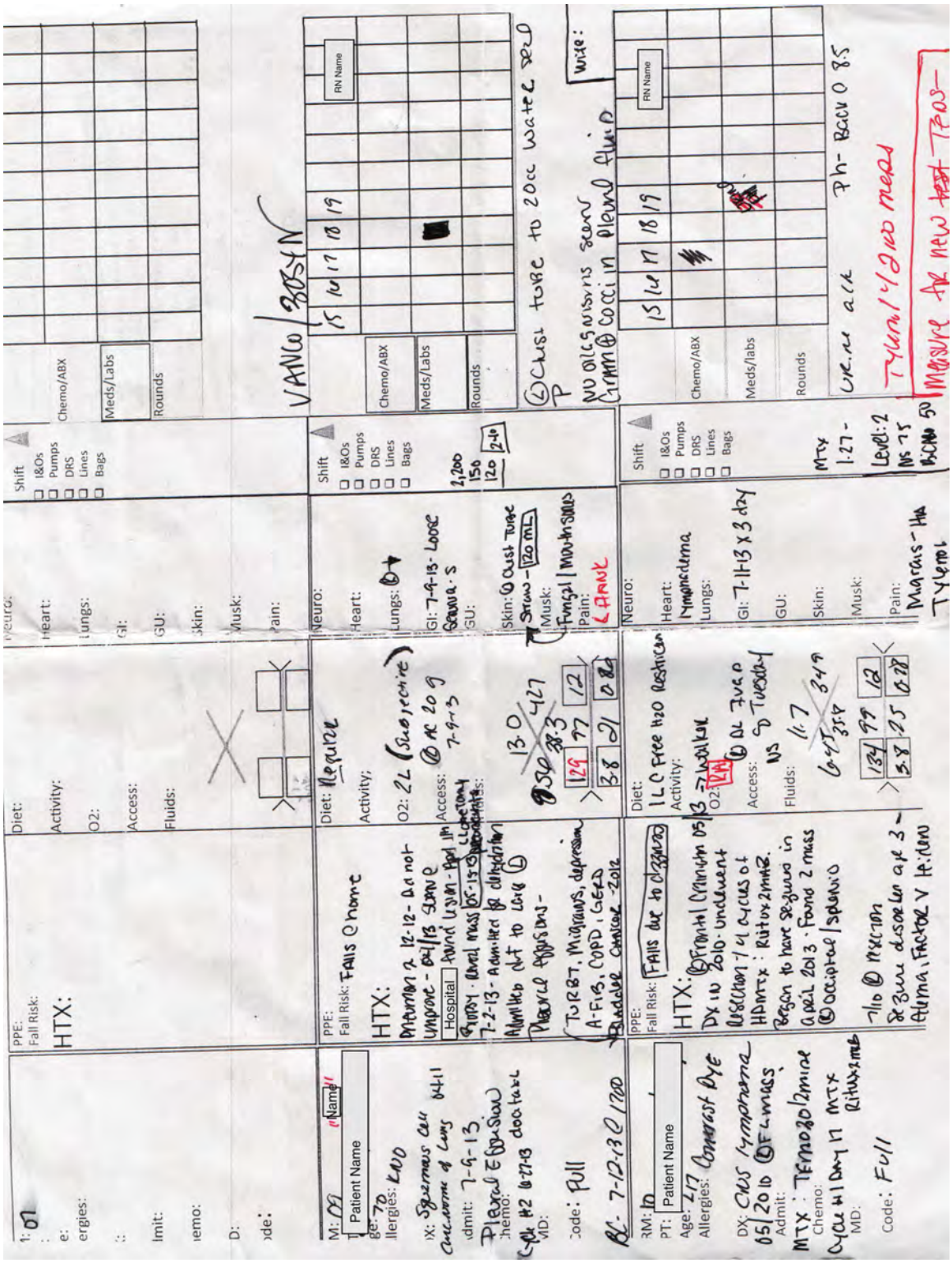


Figure 4.11. Lucy's Brain.

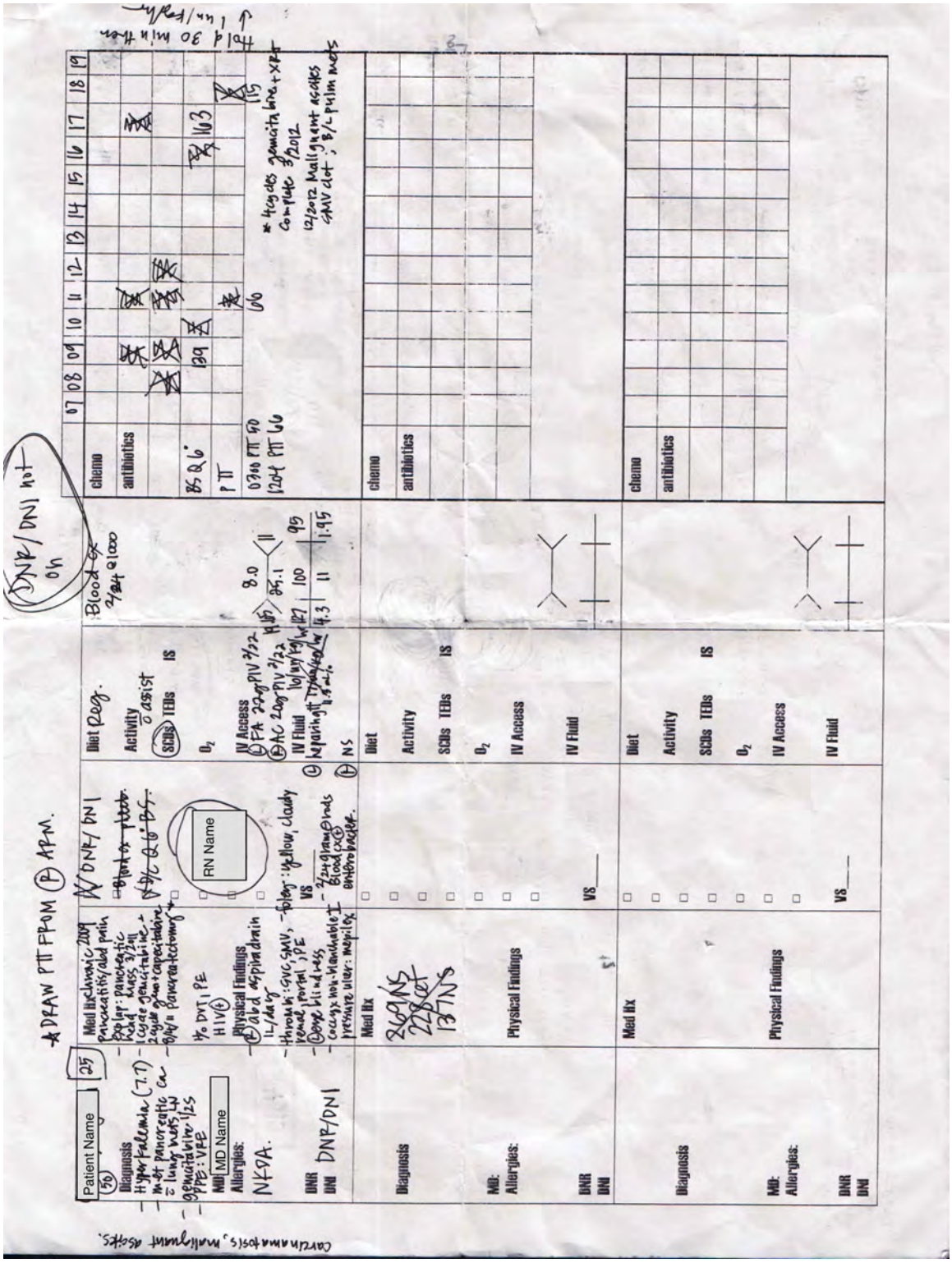


Figure 4.12. Olivia's Brain.

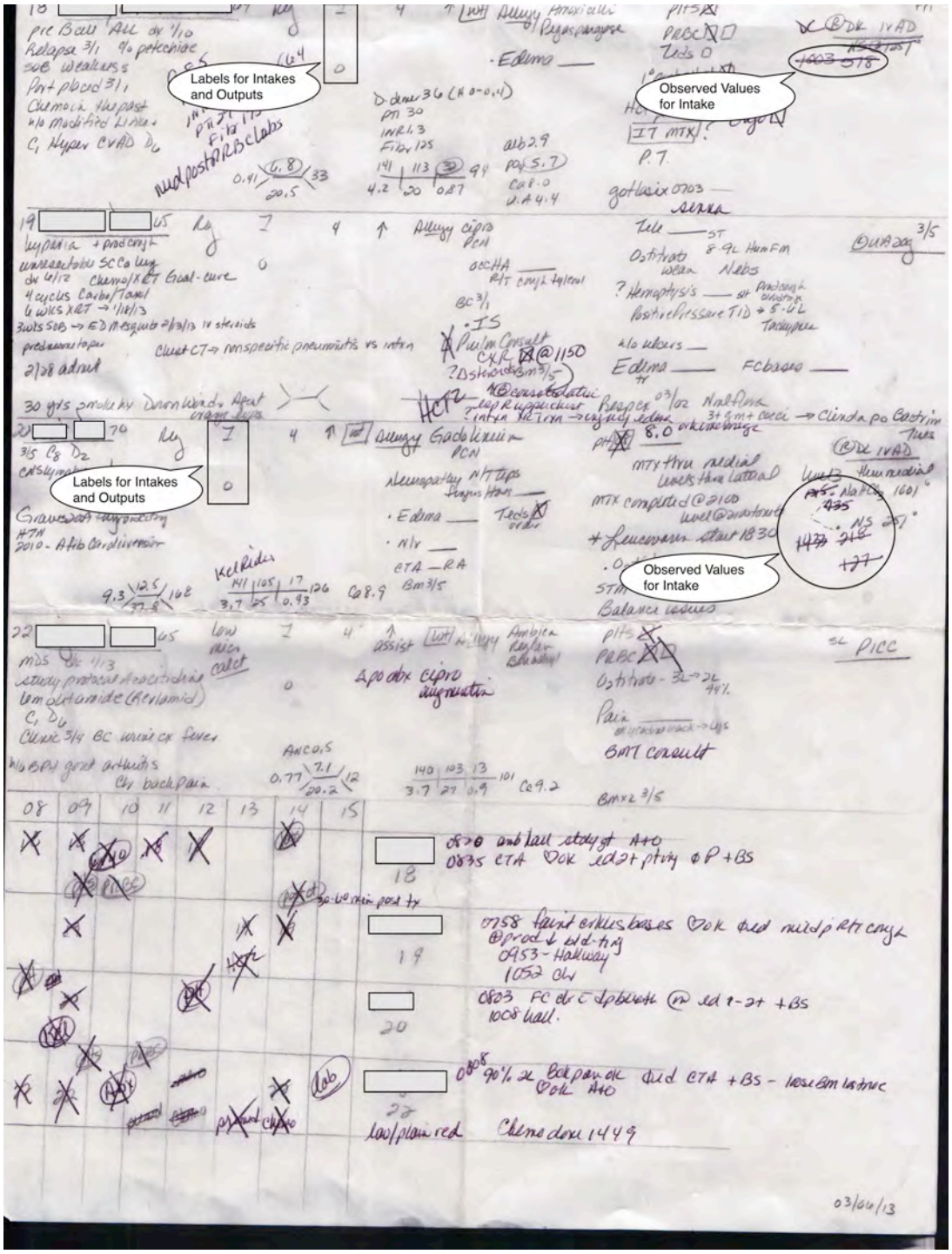


Figure 4.13. Zoe's Brain with Labels and Values of Intakes and Outputs Indicated.

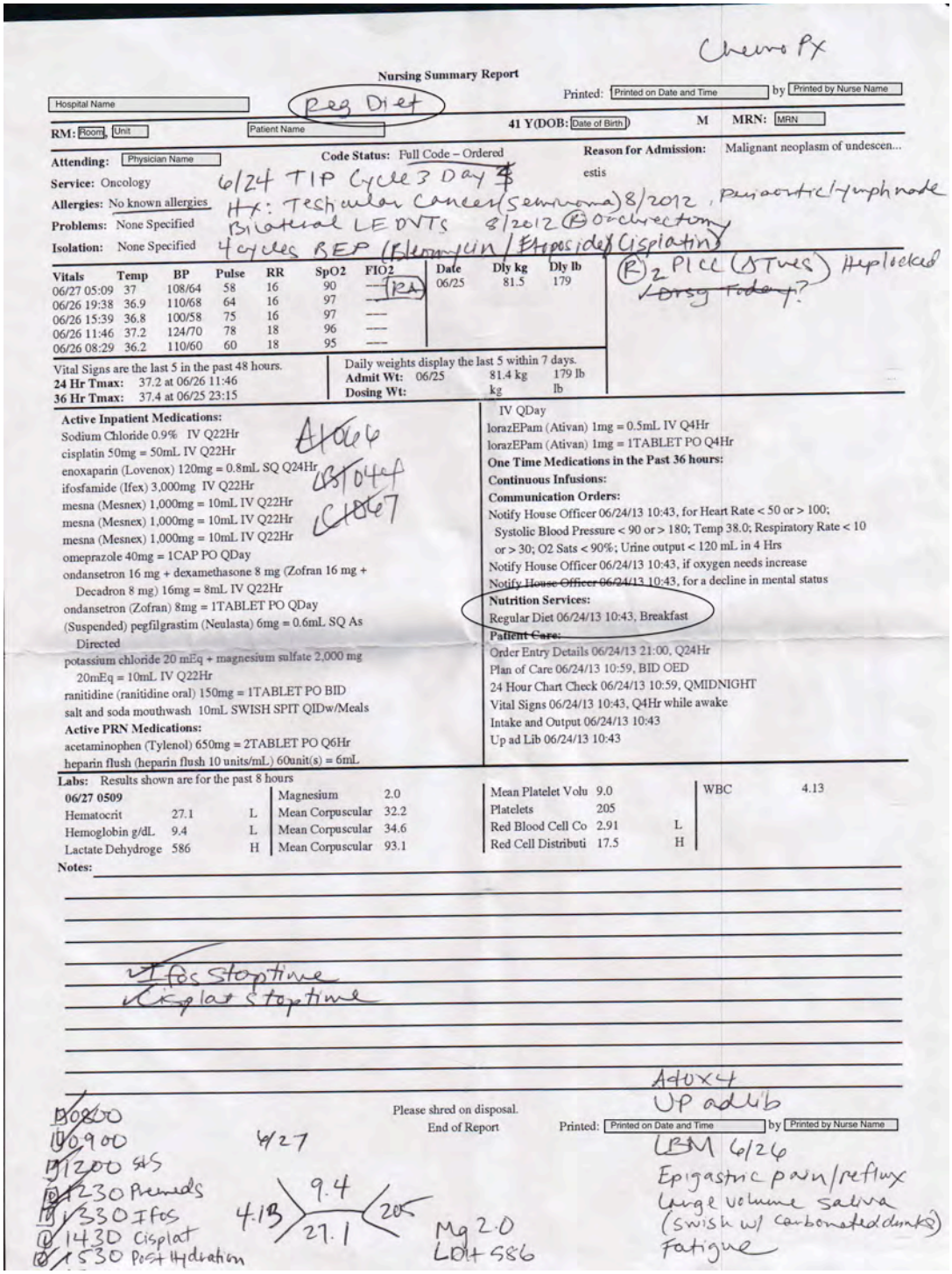
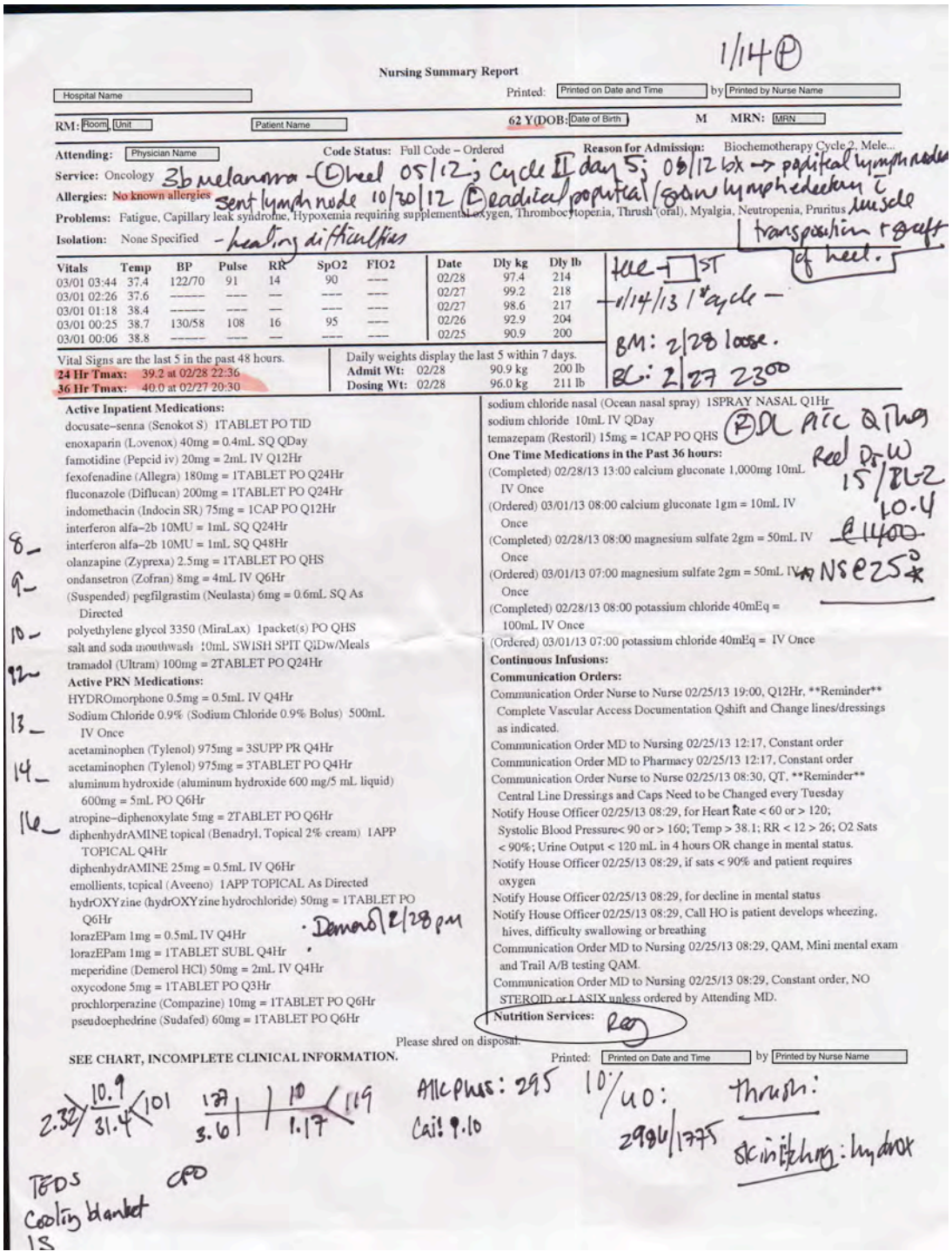


Figure 4.14. Kiera's Nursing Summary Report with Diet Order Indicated with an Oval.



Nursing Summary Report

Hospital Name | Printed: Printed on Date and Time by Printed by Nurse Name

RM: Room, Unit | Patient Name | 62 Y(DOB: Date of Birth | M | MRN: MRN

Attending: Physician Name | Code Status: Full Code – Ordered | Reason for Admission: Biochemotherapy Cycle 2, Mele...

Service: Oncology

Allergies: No known allergies

Problems: Fatigue, Capillary leak syndrome, Hypoxemia requiring supplemental oxygen, Thrombocytopenia, Thrush (oral), Myalgia, Neutropenia, Pruritus

Isolation: None Specified

Vitals	Temp	BP	Pulse	RR	SpO2	FIO2
03/01 03:44	37.4	122/70	91	14	90	---
03/01 02:26	37.6	------	---	---	---	---
03/01 01:18	38.4	------	---	---	---	---
03/01 00:25	38.7	130/58	108	16	95	---
03/01 00:06	38.8	------	---	---	---	---

Vital Signs are the last 5 in the past 48 hours.
24 Hr Tmax: 39.2 at 02/28 22:36
36 Hr Tmax: 40.0 at 02/27 20:30

Date	Dly kg	Dly lb
02/28	97.4	214
02/27	99.2	218
02/27	98.6	217
02/26	92.9	204
02/25	90.9	200

Daily weights display the last 5 within 7 days.
Admit Wt: 02/28 90.9 kg 200 lb
Dosing Wt: 02/28 96.0 kg 211 lb

Active Inpatient Medications:
docusate–senna (Senokot S) 1TABLET PO TID
enoxaparin (Lovenox) 40mg = 0.4mL SQ QDay
famotidine (Pepcid iv) 20mg = 2mL IV Q12Hr
fexofenadine (Allegra) 180mg = 1TABLET PO Q24Hr
fluconazole (Diflucan) 200mg = 1TABLET PO Q24Hr
indomethacin (Indocin SR) 75mg = 1CAP PO Q12Hr
interferon alfa–2b 10MU = 1mL SQ Q24Hr
interferon alfa–2b 10MU = 1mL SQ Q48Hr
olanzapine (Zyprexa) 2.5mg = 1TABLET PO QHS
ondansetron (Zofran) 8mg = 4mL IV Q6Hr
(Suspended) pegfilgrastim (Neulasta) 6mg = 0.6mL SQ As Directed
polyethylene glycol 3350 (MiraLax) 1packet(s) PO QHS
salt and soda mouthwash 10mL SWISH SPIT QiDw/Meals
tramadol (Ultram) 100mg = 2TABLET PO Q24Hr

Active PRN Medications:
HYDROmorphone 0.5mg = 0.5mL IV Q4Hr
Sodium Chloride 0.9% (Sodium Chloride 0.9% Bolus) 500mL IV Once
acetaminophen (Tylenol) 975mg = 3SUPP PR Q4Hr
acetaminophen (Tylenol) 975mg = 3TABLET PO Q4Hr
aluminum hydroxide (aluminum hydroxide 600 mg/5 mL liquid) 600mg = 5mL PO Q6Hr
atropine–diphenoxylate 5mg = 2TABLET PO Q6Hr
diphenhydrAMINE topical (Benadryl, Topical 2% cream) 1APP TOPICAL Q4Hr
diphenhydrAMINE 25mg = 0.5mL IV Q6Hr
emollients, topical (Aveeno) 1APP TOPICAL As Directed
hydrOXYzine (hydrOXYzine hydrochloride) 50mg = 1TABLET PO Q6Hr
lorazEPam 1mg = 0.5mL IV Q4Hr
lorazEPam 1mg = 1TABLET SUBL Q4Hr
meperidine (Demerol HCl) 50mg = 2mL IV Q4Hr
oxycodone 5mg = 1TABLET PO Q3Hr
prochlorperazine (Compazine) 10mg = 1TABLET PO Q6Hr
pseudoephedrine (Sudafed) 60mg = 1TABLET PO Q6Hr

sodium chloride nasal (Ocean nasal spray) 1SPRAY NASAL Q1Hr
sodium chloride 10mL IV QDay
temazepam (Restoril) 15mg = 1CAP PO QHS

One Time Medications in the Past 36 hours:
(Completed) 02/28/13 13:00 calcium gluconate 1,000mg 10mL IV Once
(Ordered) 03/01/13 08:00 calcium gluconate 1gm = 10mL IV Once
(Completed) 02/28/13 08:00 magnesium sulfate 2gm = 50mL IV Once
(Ordered) 03/01/13 07:00 magnesium sulfate 2gm = 50mL IV Once
(Completed) 02/28/13 08:00 potassium chloride 40mEq = 100mL IV Once
(Ordered) 03/01/13 07:00 potassium chloride 40mEq = IV Once

Continuous Infusions:

Communication Orders:
Communication Order Nurse to Nurse 02/25/13 19:00, Q12Hr, **Reminder** Complete Vascular Access Documentation Qshift and Change lines/dressings as indicated.
Communication Order MD to Nursing 02/25/13 12:17, Constant order
Communication Order MD to Pharmacy 02/25/13 12:17, Constant order
Communication Order Nurse to Nurse 02/25/13 08:30, QT, **Reminder** Central Line Dressings and Caps Need to be Changed every Tuesday
Notify House Officer 02/25/13 08:29, for Heart Rate < 60 or > 120; Systolic Blood Pressure< 90 or > 160; Temp > 38.1; RR < 12 > 26; O2 Sats < 90%; Urine Output < 120 mL in 4 hours OR change in mental status.
Notify House Officer 02/25/13 08:29, if sats < 90% and patient requires oxygen
Notify House Officer 02/25/13 08:29, for decline in mental status
Notify House Officer 02/25/13 08:29, Call HO is patient develops wheezing, hives, difficulty swallowing or breathing
Communication Order MD to Nursing 02/25/13 08:29, QAM, Mini mental exam and Trail A/B testing QAM.
Communication Order MD to Nursing 02/25/13 08:29, Constant order, NO STEROID or LASIX unless ordered by Attending MD.

Nutrition Services: Reg

Please shred on disposal.

SEE CHART, INCOMPLETE CLINICAL INFORMATION.

Printed: Printed on Date and Time by Printed by Nurse Name

1/14 (P)

3b melanoma – (D) heel 05/12; Cycle II day 5; 08/12 Rx → popliteal lymph node sent lymph node 10/30/12 (D) radical popliteal/groin lymphadenectomy & muscle transposition & graft of heel.

healing difficulties

1/14/13 1st cycle –

BM: 2/28 loose.

BC: 2/27 2300

Reg D5W 15/BL2 10.4 @1400 NS @25*

Demerol 2/28 pm

Alk Phos: 295 Ca: 9.10

10/40: 2986/1775

Thrush:

skin itching: hydrox

TEDS

Cooling blanket

CPO

IS

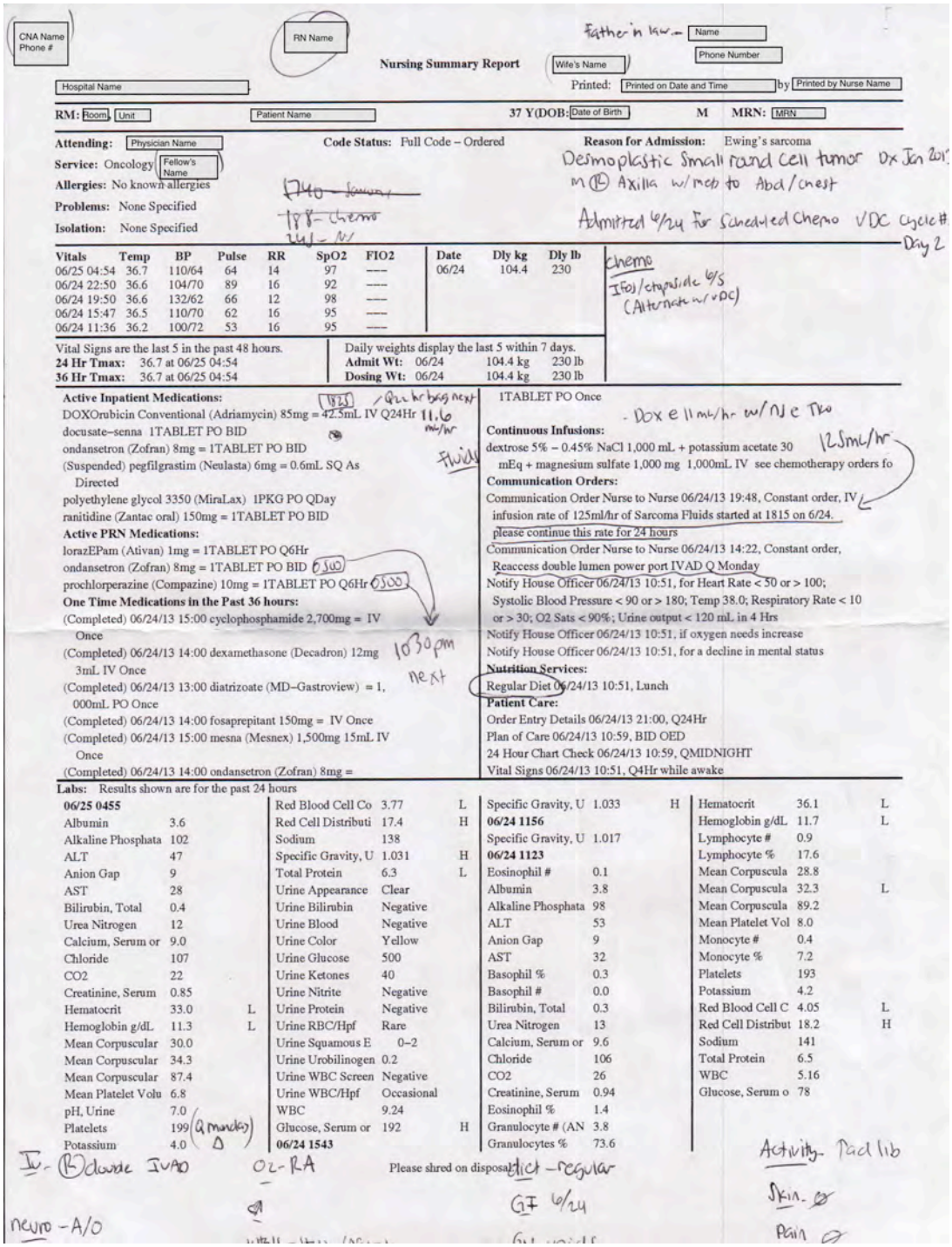
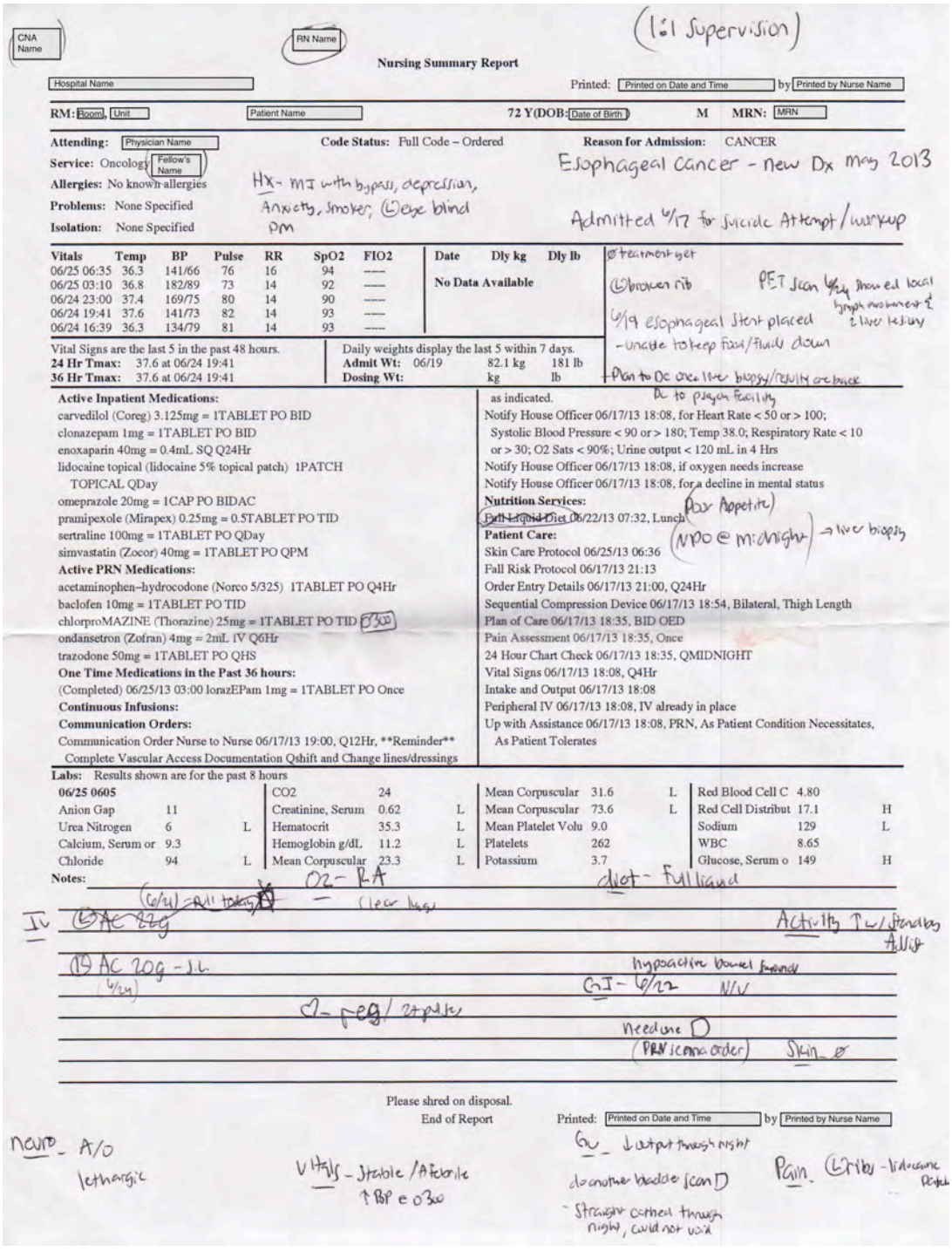

CNA Name
Phone #
RN Name
Father in law — Name
Phone Number
Nursing Summary Report
Wife's Name
Hospital Name
Printed: Printed on Date and Time by Printed by Nurse Name
RM: Room Unit
Patient Name
37 Y(DOB: Date of Birth M MRN: MRN
Attending: Physician Name
Code Status: Full Code – Ordered
Reason for Admission: Ewing's sarcoma
Desmoplastic Small round cell tumor Dx Jan 201
Service: Oncology Fellow's Name
MR Axilla w/ mets to Abd/chest
Allergies: No known allergies
Problems: None Specified
Isolation: None Specified
Admitted 6/24 for Scheduled Chemo VDC cycle #
Day 2
chemo
Ifos/etoposide 6/5
(Alternate w/ VDC)
Vitals Temp BP Pulse RR SpO2 FIO2
06/25 04:54 36.7 110/64 64 14 97 ----
06/24 22:50 36.6 104/70 89 16 92 ----
06/24 19:50 36.6 132/62 66 12 98 ----
06/24 15:47 36.5 110/70 62 16 95 ----
06/24 11:36 36.2 100/72 53 16 95 ----
Date Dly kg Dly lb
06/24 104.4 230
Vital Signs are the last 5 in the past 48 hours.
24 Hr Tmax: 36.7 at 06/25 04:54
36 Hr Tmax: 36.7 at 06/25 04:54
Daily weights display the last 5 within 7 days.
Admit Wt: 06/24 104.4 kg 230 lb
Dosing Wt: 06/24 104.4 kg 230 lb
Active Inpatient Medications:
DOXOrubicin Conventional (Adriamycin) 85mg = 42.5mL IV Q24Hr
docusate–senna 1TABLET PO BID
ondansetron (Zofran) 8mg = 1TABLET PO BID
(Suspended) pegfilgrastim (Neulasta) 6mg = 0.6mL SQ As Directed
polyethylene glycol 3350 (MiraLax) 1PKG PO QDay
ranitidine (Zantac oral) 150mg = 1TABLET PO BID
Active PRN Medications:
lorazEPam (Ativan) 1mg = 1TABLET PO Q6Hr
ondansetron (Zofran) 8mg = 1TABLET PO BID
prochlorperazine (Compazine) 10mg = 1TABLET PO Q6Hr
One Time Medications in the Past 36 hours:
(Completed) 06/24/13 15:00 cyclophosphamide 2,700mg = IV Once
(Completed) 06/24/13 14:00 dexamethasone (Decadron) 12mg 3mL IV Once
(Completed) 06/24/13 13:00 diatrizoate (MD–Gastroview) = 1,000mL PO Once
(Completed) 06/24/13 14:00 fosaprepitant 150mg = IV Once
(Completed) 06/24/13 15:00 mesna (Mesnex) 1,500mg 15mL IV Once
(Completed) 06/24/13 14:00 ondansetron (Zofran) 8mg =
1TABLET PO Once
Continuous Infusions:
dextrose 5% – 0.45% NaCl 1,000 mL + potassium acetate 30 mEq + magnesium sulfate 1,000 mg 1,000mL IV see chemotherapy orders fo
Communication Orders:
Communication Order Nurse to Nurse 06/24/13 19:48, Constant order, IV infusion rate of 125ml/hr of Sarcoma Fluids started at 1815 on 6/24.
please continue this rate for 24 hours
Communication Order Nurse to Nurse 06/24/13 14:22, Constant order, Reaccess double lumen power port IVAD Q Monday
Notify House Officer 06/24/13 10:51, for Heart Rate < 50 or > 100; Systolic Blood Pressure < 90 or > 180; Temp 38.0; Respiratory Rate < 10 or > 30; O2 Sats < 90%; Urine output < 120 mL in 4 Hrs
Notify House Officer 06/24/13 10:51, if oxygen needs increase
Notify House Officer 06/24/13 10:51, for a decline in mental status
Nutrition Services:
Regular Diet 06/24/13 10:51, Lunch
Patient Care:
Order Entry Details 06/24/13 21:00, Q24Hr
Plan of Care 06/24/13 10:59, BID OED
24 Hour Chart Check 06/24/13 10:59, QMIDNIGHT
Vital Signs 06/24/13 10:51, Q4Hr while awake
Labs: Results shown are for the past 24 hours
06/25 0455
Albumin 3.6
Alkaline Phosphata 102
ALT 47
Anion Gap 9
AST 28
Bilirubin, Total 0.4
Urea Nitrogen 12
Calcium, Serum or 9.0
Chloride 107
CO2 22
Creatinine, Serum 0.85
Hematocrit 33.0 L
Hemoglobin g/dL 11.3 L
Mean Corpuscular 30.0
Mean Corpuscular 34.3
Mean Corpuscular 87.4
Mean Platelet Volu 6.8
pH, Urine 7.0
Platelets 199
Potassium 4.0
Red Blood Cell Co 3.77 L
Red Cell Distributi 17.4 H
Sodium 138
Specific Gravity, U 1.031 H
Total Protein 6.3 L
Urine Appearance Clear
Urine Bilirubin Negative
Urine Blood Negative
Urine Color Yellow
Urine Glucose 500
Urine Ketones 40
Urine Nitrite Negative
Urine Protein Negative
Urine RBC/Hpf Rare
Urine Squamous E 0–2
Urine Urobilinogen 0.2
Urine WBC Screen Negative
Urine WBC/Hpf Occasional
WBC 9.24
Glucose, Serum or 192 H
06/24 1543
Specific Gravity, U 1.033 H
06/24 1156
Specific Gravity, U 1.017
06/24 1123
Eosinophil # 0.1
Albumin 3.8
Alkaline Phosphata 98
ALT 53
Anion Gap 9
AST 32
Basophil % 0.3
Basophil # 0.0
Bilirubin, Total 0.3
Urea Nitrogen 13
Calcium, Serum or 9.6
Chloride 106
CO2 26
Creatinine, Serum 0.94
Eosinophil % 1.4
Granulocyte # (AN 3.8
Granulocytes % 73.6
Hematocrit 36.1 L
Hemoglobin g/dL 11.7 L
Lymphocyte # 0.9
Lymphocyte % 17.6
Mean Corpuscula 28.8
Mean Corpuscula 32.3 L
Mean Corpuscula 89.2
Mean Platelet Vol 8.0
Monocyte # 0.4
Monocyte % 7.2
Platelets 193
Potassium 4.2
Red Blood Cell C 4.05 L
Red Cell Distribut 18.2 H
Sodium 141
Total Protein 6.5
WBC 5.16
Glucose, Serum o 78
Please shred on disposal

Figure 4.16. Collette's Nursing Summary Report for Patient 1.



CNA Name

RN Name

(1:1 Supervision)

Nursing Summary Report

Hospital Name

Printed: Printed on Date and Time by Printed by Nurse Name

RM: Room, Unit | Patient Name | 72 Y(DOB: Date of Birth) M | MRN: MRN

Attending: Physician Name
Service: Oncology Fellow's Name
Allergies: No known allergies
Problems: None Specified
Isolation: None Specified

Code Status: Full Code – Ordered

Reason for Admission: CANCER

Esophageal cancer - new Dx May 2013

Hx- MI with bypass, depression, Anxiety, Smoker, (L)eye blind pm

Admitted 6/17 for suicide Attempt/workup

Vitals	Temp	BP	Pulse	RR	SpO2	FIO2
06/25 06:35	36.3	141/66	76	16	94	----
06/25 03:10	36.8	182/89	73	14	92	----
06/24 23:00	37.4	169/75	80	14	90	----
06/24 19:41	37.6	141/73	82	14	93	----
06/24 16:39	36.3	134/79	81	14	93	----

Vital Signs are the last 5 in the past 48 hours.
24 Hr Tmax: 37.6 at 06/24 19:41
36 Hr Tmax: 37.6 at 06/24 19:41

Date	Dly kg	Dly lb
No Data Available		

Daily weights display the last 5 within 7 days.
Admit Wt: 06/19 82.1 kg 181 lb
Dosing Wt: kg lb

Ø treatment yet
(L)broken rib
PET scan 6/24 showed local lymph involvement & liver lesion
6/19 esophageal stent placed
-unable to keep food/fluids down
Plan to Dc once liver biopsy/results are back
Dc to player facility

Active Inpatient Medications:
carvedilol (Coreg) 3.125mg = 1TABLET PO BID
clonazepam 1mg = 1TABLET PO BID
enoxaparin 40mg = 0.4mL SQ Q24Hr
lidocaine topical (lidocaine 5% topical patch) 1PATCH TOPICAL QDay
omeprazole 20mg = 1CAP PO BIDAC
pramipexole (Mirapex) 0.25mg = 0.5TABLET PO TID
sertraline 100mg = 1TABLET PO QDay
simvastatin (Zocor) 40mg = 1TABLET PO QPM

Active PRN Medications:
acetaminophen–hydrocodone (Norco 5/325) 1TABLET PO Q4Hr
baclofen 10mg = 1TABLET PO TID
chlorproMAZINE (Thorazine) 25mg = 1TABLET PO TID Ø300
ondansetron (Zofran) 4mg = 2mL IV Q6Hr
trazodone 50mg = 1TABLET PO QHS

One Time Medications in the Past 36 hours:
(Completed) 06/25/13 03:00 lorazEPam 1mg = 1TABLET PO Once

Continuous Infusions:

Communication Orders:
Communication Order Nurse to Nurse 06/17/13 19:00, Q12Hr, **Reminder** Complete Vascular Access Documentation Qshift and Change lines/dressings as indicated.
Notify House Officer 06/17/13 18:08, for Heart Rate < 50 or > 100; Systolic Blood Pressure < 90 or > 180; Temp 38.0; Respiratory Rate < 10 or > 30; O2 Sats < 90%; Urine output < 120 mL in 4 Hrs
Notify House Officer 06/17/13 18:08, if oxygen needs increase
Notify House Officer 06/17/13 18:08, for a decline in mental status

Nutrition Services:
~~Full Liquid Diet~~ 06/22/13 07:32, Lunch (Poor Appetite)
(NPO @ midnight → liver biopsy

Patient Care:
Skin Care Protocol 06/25/13 06:36
Fall Risk Protocol 06/17/13 21:13
Order Entry Details 06/17/13 21:00, Q24Hr
Sequential Compression Device 06/17/13 18:54, Bilateral, Thigh Length
Plan of Care 06/17/13 18:35, BID OED
Pain Assessment 06/17/13 18:35, Once
24 Hour Chart Check 06/17/13 18:35, QMIDNIGHT
Vital Signs 06/17/13 18:08, Q4Hr
Intake and Output 06/17/13 18:08
Peripheral IV 06/17/13 18:08, IV already in place
Up with Assistance 06/17/13 18:08, PRN, As Patient Condition Necessitates, As Patient Tolerates

Labs: Results shown are for the past 8 hours

06/25 0605			CO2	24		Mean Corpuscular	31.6	L	Red Blood Cell C	4.80	
Anion Gap	11		Creatinine, Serum	0.62	L	Mean Corpuscular	73.6	L	Red Cell Distribut	17.1	H
Urea Nitrogen	6	L	Hematocrit	35.3	L	Mean Platelet Volu	9.0		Sodium	129	L
Calcium, Serum or	9.3		Hemoglobin g/dL	11.2	L	Platelets	262		WBC	8.65	
Chloride	94	L	Mean Corpuscular	23.3	L	Potassium	3.7		Glucose, Serum o	149	H

Notes:
O2- RA
diet- Full liquid
(6/24) -All today
clear liquid
IV
(B)AC 20g
Activity I w/ steroids Adlib
(B) AC 20g - J.L. (6/24)
hypoactive bowel sounds
GI- 6/22 N/V
Ø- peg/ zofran
needs Dc (PRN iconna order)
Skin- Ø

Please shred on disposal.
End of Report

Printed: Printed on Date and Time by Printed by Nurse Name

neuro- A/O lethargic
VHalls - Stable / Afebrile ↑BP e 0300
GU- ↓ output through night do another bladder scan ? - Straight cathed through night, could not void
Pain- (L)rib - lidocaine Patch

Figure 4.17. Collette's Nursing Summary Report for Patient 2.

Table 4.1: Information Content of Brains by Type.

	Free Form (n=3)	Skeleton (n=7)	NSR† (n=3)
Patient Identifiers			
Name	3	7	3
Age	3	7	3
DOB	0	0	3
Gender	0	2	3
Admission Demographics			
MRN	1	1	3
Room Number	3	7	3
Unit	0	0	3
Hospital Name	0	0	3
Attending MD	3	2	3
Service	0	1	3
Admit Date	2	4	3
Today's Date	2	1	3
Alerts			
Allergies	3	7	3
Isolation Status	0	2	3
Code Status	2	7	3
Fall Risk	2	4	2
1:1 Supervision	1	0	1
Problems			
Cancer Diagnosis	3	7	3
Reason for Admission	2	7	3
Current Problems	3	7	3
History			
Past Medical/Surgical History	3	7	3
Past Cancer History	3	7	3
Current Hospitalization	3	7	3
Social History			
Smoking Status	1	3	2
Alcohol/Drug Use	0	2	2
Living Situation	0	1	1
Marital Status	0	0	1
Occupation	0	1	0
Family Contact Information	1	1	3
Physical Findings			
Last Bowel Movement (Date only)	3	6	3
Last Bowel Movement (Date plus assessment)	2	1	3
Other Physical Findings	3	7	3
Assessment			
Organized by Body System	1	2	1

†Nursing Summary Report

Table 4.1 continued

	Free Form (n=3)	Skeleton (n=7)	NSR† (n=3)
Not Organized by Body System	2	5	2
Orders			
Diet	3	7	3
Activity	3	6	3
Oxygen	2	6	3
Blood Products	1	2	1
Chemotherapy	3	3	3
Daily Weights	2	3	3
Other Orders	3	3	3
IV Access	3	7	3
IV Fluid	3	7	3
Equipment			
Ted Hose	2	3	2
SCDs	2	3	2
Incentive Spirometer	3	5	1
Telemetry	3	3	1
Foley	0	2	1
Other Equipment	1	4	1
Lab Results			
CBC at Shift Start	2	7	3
CBC Updates During Shift	1	1	0
BMP at Shift Start	2	7	3
BMP Updates During Shift	0	1	0
Other Lab Results	3	7	3
Result Direction	1	2	3
Cultures			
Blood	3	4	3
Urine	0	4	3
Stool	0	2	1
Consultation			
Name of Consult	2	5	2
Reason for Consultation	0	3	2
Findings (if any)	0	2	1
Procedures			
Name of Procedure	3	6	3
Reason for Procedure	1	2	2
Findings	1	2	2
Time of Procedure	1	3	3

†Nursing Summary Report

Table 4.1 continued

	Free Form (n=3)	Skeleton (n=7)	NSR† (n=3)
Vital Signs			
Full Set	1	0	3
Only Out of Range Values	2	4	0
Multiple Sets	2	0	3
Ordered Frequency	3	2	3
Pain			
PCA Information	0	2	0
PRN Medications	2	5	3
Location of Pain	3	5	3
Controlled	0	0	2
Intakes and Outputs			
Intake Value Only	2	2	2
Intake Name/Route/Value	3	6	3
Output Value Only	0	2	0
Reminders			
Verify Information from Chart or Report	2	4	3
Communication to Another Provider/Patient/Family	1	2	3
Charting	1	2	2
Other Tasks	3	7	3
Medication Information			
Name of the Medication	3	6	3
Dose	1	4	3
Route		4	3
Frequency Ordered	2	3	3
When it Was Last Given	3	5	3
Suspended	1	1	3
Protocols			
Chemotherapy	1	1	3
Other	2	3	3
Other Providers Names			
CNA Name	2	3	1
CNA Phone Number	1	3	1
Handoff Nurse Name	1	3	1
Discharge Disposition			
Plan	1	1	1
Date	1	0	1
Patient Preferences	2	3	3

†Nursing Summary Report

CHAPTER 5

DISCUSSION

The purpose of this research was to develop a deep understanding of nurses' paper brains in the context of a medical oncology unit at a cancer hospital in an academic health sciences center. The results revealed four main concepts: paper brains provide cognitive support, brains are a representation of nurse identity, brains represent the patient, and brains are living objects. These findings suggest that though paper brains do provide cognitive support, they are not merely cognitive artifacts. Brains' exist as an external symbol of identity, personality, and autonomy–traits not usually associated with cognitive artifacts. This suggests that a successful electronic brain is unlikely given the current state of technology due to limitations of data entry and the size and weight of devices available today. These findings will be discussed and a series of suggestions for future development of electronic tools will be given. Study contributions, limitations, and future research directions will be also be addressed.

5.1 Cognitive Support

Nurses' paper brains have been characterized as cognitive artifacts (Collins et al., 2011; McLane et al., 2009, 2010; Randell et al., 2010; Staggers et al., 2011; S. Wilson et al., 2007). Cognitive artifacts support individuals by offloading part of the cognitive work required by the human mind to an external object. Jones and Nemeth (2005) claim that cognitive artifacts are an embodiment of cognitive support needs because they are created by the individuals who use them as an essential part of workflow. Because human beings vary in cognitive abilities and work styles, nurses' brains are expected to exhibit differences across individuals.

Though nurses' brains are individualized for use by a specific nurse, similarities across brains exist. The brains observed in this study fell into three broad types: free-form, skeleton, and the EHR-generated Nursing Summary Report. Nurses in this study expressed that they used a specific format because it matched how they thought about their patients

and their practice. Nurses respected differences among formats, recognizing that though their particular format worked for them, it might not work for everyone. Still, nurses were happy to share their individual formats with other nurses to help them find what might work in their practice.

These results align with previous research about the variety of informal handoff documentation. Hardey et al. (2000) observed that informal handoff documentation is designed and owned by individual nurses. The results of Staggers et al. (2011) described continued use of tailored paper-based tools designed by individual nurses, despite the availability of a computerized form integrated with the EHR. In a report of a quality improvement project, Klee et al. (2012) state that the development of a single, standardized tool to replace the numerous individual forms for handoff was a fundamental goal of the project. The results of this study suggest, however, that standardization into a single form may not be advisable. Multiple versions of a standardized tool may be indicated to support differences in nurses' cognitive needs, expression of nurse identity, and tailored to specific context. Allowing multiple designs would limit variability in handoff communication as recommended by the Joint Commission in 2006 (2005), but still support individual differences in nursing learning styles and internal patient schema.

The content of nurses' brains fell into 21 specific categories. Though the context of this study is different, these categories align with the findings of Collins et al. (2011) in a review of the content in handoff artifacts for nurses and physicians. Though data from every category appeared in all brains, the inclusion of specific items varied across patients within individual brains. According to the nurses in this study, patient context influenced their decision to include specific items, only writing down data items that would add to their constructed "story of the patient." These findings agree with those of (Collins et al., 2011; Hardey et al., 2000; Staggers & Jennings, 2009; Staggers et al., 2011). Some data items were not printed on the EHR-generated Nursing Summary Report and were added by hand by the nurses. These were items such as prior medical history and recent physical findings that were stored in the EHR as free-text files. Free-text files must first be processed, either through natural language processing methods or by a human user, to abstract the specific history and findings pertinent to the shift. This makes it difficult to obtain a report compiled by the EHR that includes all required data for nurses to know their patients. Future development of tools designed to be completely electronic will need to address this limitation.

The most salient difference in content between the Nursing Summary Report and other

types of brains was the number of data items. The Nursing Summary Report printed a comprehensive list of lab results, some of which were never seen in other types of brains. Examples include counts and percentages of specific granulocytes, and detailed results from urinalysis. This difference may be due to a lack of specificity in information requirements given to the designers of the Nursing Summary Report. The Nursing Summary Report was designed with input from acute care nurses working in the University of Utah Hospital System, including staff nurses from the medical oncology unit observed in this study. During interviews for this study, nurses describing the content of their brains used general terms like "labs" and "orders" for groups of data. When asked, "Which labs have you written?" or "Which orders do you need?" nurses would respond with indicators of timing such as "most recent," "last set," or "pending orders," rather than give specific names of labs or orders. Given these tendencies, development of a Nursing Summary Report listing all lab results, rather than just the 11 nurses copy into the CBC and BMP fishbone diagrams, is understandable. Future designs of EHR-integrated report summaries need to take into consideration the information actually appearing on free-form and skeleton brains, since nurses' descriptions of this information may be less specific than required for programmers to develop a usable tool.

As seen in previous studies (Hardey et al., 2000; Kelley, Docherty, & Brandon, 2013; Randell et al., 2011, 2008, 2010; Staggers et al., 2012, 2011; S. Wilson et al., 2007), nurses in this study used their paper brains as the primary source of information given during report. Nurses who constructed their own free-form or skeleton brains described the organization of their brains as having a flow that was used to give report at handoff. This organization gave nurses support when constructing a coherent narrative about each patient and the care that had been given during the shift. Interestingly, the single instance of flow of a brain not matching the flow of report was described by Felix, who claimed he did not know how to make a brain and used what more experienced nurses had given him. In contrast, nurses who used the Nursing Summary Report did not mention the flow of report at all. These nurses spoke only about their brains having the information for report, but did not mention flow.

An aspect of brain organization utilized in all types of brains was emphasizing crucial information. Information that indicated possible changes in patients' conditions was emphasized through placement on the page and mark ups like highlighting or circling. Emphasis worked as a visual trigger to ensure the nurse would be aware of essential information when providing care. Highlighting and circling information allowed nurses to give selected

information more visual importance, particularly on the Nursing Summary Report. Visual emphasis supports nurses' need for "at a glance" information retrieval. Though free-form and skeleton brains frequently emphasized information through placement, mark ups were the only way to add visual importance to information in the Nursing Summary Report because of its rigid design.

5.2 Nurse Identity

Nurses' brains were presented as personal representations of themselves and their practice. To the author's knowledge, this finding is unique among the literature about nursing handoff. Nurses likened their paper brains to parts of themselves, even showing affection toward the objects through hugs and other similar gestures. Though other providers were observed carrying paper notes during rounds, these notes were less individualized and less personal than those carried by nurses. Nurses were also protective of their brains, expressing fear that this study might result in their paper brains being taken away from them. This was in contrast to other providers who referred to their cognitive artifacts as "notes"—a much less telling word than "brains"—and would willingly give their paper-based notes to another provider to view and modify.

Nurses who used free-form and skeleton brains related to their brains in a more personal way than nurses who used the Nursing Summary Report. Free-form and skeleton brains users would describe their brains as a piece of themselves. On the other hand, Nursing Summary Report users would describe how their choice of brain made them appear professional to an external audience: their patients and other providers. These observations align with the symbolic interactionist concepts of "I" and "Me" as put forth by George Herbert Mead 1970. The "I" is the subjective self, the internal understanding constructed by an individual, i.e., "Who am I?" Free-form and skeleton discussed their papers brains from this perspective—"This is how *I* work," and "This is who *I* am as a nurse." The "Me" is an understanding of self derived from interaction with others and the environment, the socialized self, i.e., "How do others see *me*?" Nursing Summary Report users discussed their nursing identity from this external perspective. The nurses who chose the Nursing Summary Report on this unit were younger and less experienced than nurses who chose to use free-form and skeleton brains. These younger nurses may not have had time to develop an internal nurse identity, and so focus may be limited to how others view their brains. For example, Lucy's lack of emotional connection with her skeleton brain may provide support of this view.

Nurses in this study described their brains as an indicator of the importance of autonomy in nursing practice and discussed paper brains as a means to express this autonomy. Autonomy has been shown to be correlated with job satisfaction (Aldridge, 1994; McWilliam & Wong, 1994; Shea, 2015; Wade, 1999), and has been described as a defining attribute of job satisfaction in nurses in a recent concept analysis (Castaneda & Scanlan, 2014). Paper brains represent a means of having control over individual nurses' practice, leading to a feeling of autonomy in the role of a nurse. Nurse managers and hospital administrators seeking to make changes to the handoff process will need to consider how nurses express themselves through their paper brains. Making sure nurses' individual voices are heard before implementing changes, and allowing individuality to be expressed in paper brains, may alleviate unexpected consequences of policy changes.

5.3 Patient Representation

Nurses' brains evidence a need for nurses to further process and synthesize medical information from the EHR into a picture or story of the patient. "Knowing the patient" has been described previously and is believed by nursing scholars to be at the heart of quality patient care (Bonis, 2009; Bruni, Gherardi, & Parolin, 2007; Paton, 2007). Kelley et al. (2013) demonstrated that nurses' report sheets (i.e., paper brains) are viewed by nurses as the most valuable information source for knowing the patient, and that information saved in the EHR as "nurse documentation" was not viewed as important as the authors hypothesized. The results of this study, taken with those of Kelley et al., indicate nursing knowledge is not sufficiently captured in current EHR documentation in general. This may stem from historical assumptions that nursing knowledge is of less value in comparison with medical knowledge (Boyle, 1984; Doering, 1992; Ekman & Segesten, 1995). Knowing in nursing is more interpretive than the objective knowledge traditionally valued by medicine and manifests from a profound relationship between nurse and patient that is difficult to articulate (Bundgaard, Nielsen, Delmar, & Sørensen, 2012; Jenny & Logan, 1992; Kelley et al., 2013; Radwin, 1995; Tanner, Benner, Chesla, & Gordon, 1993). Sharon's poignant expression of affection demonstrates that paper brains act as a tangible physical representation of this relationship. Within this relationship, knowing arises in the nurse via a continuous assessment and understanding of patients' needs (Kelley et al., 2013; Leight, 2002; Radwin, 1995). The nurses in this study indeed described such a process and told of using their paper brains to construct and store the "story of the patient" for use during the shift. These findings concur with published literature about EHR usability (Guo,

Iribarren, Kapsandoy, Perri, & Staggers, 2011; Hyun, Johnson, Stetson, & Bakken, 2009; Keenan, Yake, Lopez, Tschannen, & Ford, 2013; Page & Schadler, 2014; Rogers, Sockolow, Bowles, Hand, & George, 2013; Staggers & Rodney, 2012).

For nurses who favored the free-form and skeleton style, the story of the patient is clearly at the center of their nursing practice. On these brains, information was often grouped so that patient context, or story, was central. This story informed nurses' decision making by bringing focus onto indications of change in patients' trajectory. This focus enabled a complete picture of the patient as a whole that makes nursing practice different from other providers. Nurses who used the Nursing Summary Report were less likely to describe using their brains to hold a story of the patient. Though their brains display similar synthesis and modifications to bring focus onto indicators of future patient changes, they did not refer to "story" or "picture" when discussing their brains. This difference may be because the information in the Nursing Summary Report is closer to the data stored in the EHR than other types of brains. Story of the patient may be less important for these nurses than for nurses who choose to use a free-form or skeleton brain.

The story of the patient may be particularly important to nurses working specifically in a medical oncology unit. Patients in this unit experience multiple and lengthy hospital stays during their disease trajectory, allowing nurses to develop relationships with the patients. Information regarding how previous cancer treatments were tolerated, previous non-cancer-related illness, and psychosocial implications is important for safe and efficient care for the patients as they return to the unit. When patients have a shorter trajectory, nurses may not rely on a paper brain to hold the story of the patient, as that story may be less central to the care they provide. A brain closer to the EHR may suffice. Nurses in this study saw Nursing Summary Reports as sufficient when floating to other units, particularly surgical units where stays could be as short as a day.

5.4 The Living Nature of Paper Brains

The results of this study demonstrate the living nature of nurses' paper brains. Paper brains had a life cycle consisting of four phases: creation, use, reproduction, and destruction. The length of this life cycle was tied to the nurses' preferred brain type, work schedule, and the patient's disease trajectory. The length between the end of a nurse's shift and the actual destruction of a paper brain tended to be longer for free-form and skeleton brains and when nurses were scheduled to work multiple shifts in a row. The likelihood of seeing patients again and the need to know a patient's history—both related to the lengthy disease

trajectories for oncology patients—were nearly always cited as reasons for the long period of time before destruction. Because of the connection between patient trajectory and brain life cycle, brains used by nurses in units with shorter patient stays may exhibit differences in life cycle. In addition to a life cycle loosely tied to shift, brains exhibit evolution across the career of a nurse. Evolutionary changes occur in response to changes in nursing workflow. These two change processes point to the need for flexibility in future designs of standardized forms of brains. Not only will electronic brains need to be easily updated during a shift, but the overall design will need to be re-examined after changes are made to nursing workflow.

5.5 Recommendations for the Development of an Electronic Brain

Aim 2 of this dissertation research was to develop recommendations for future development of an electronic brain. However, the findings from this study indicate a successful electronic brain is unlikely until paper brains are recognized as more than mere cognitive artifacts. Future development of an electronic brain will need to address the role paper brains play in representing nurse identity and patients beyond information on a screen.

Nurses in this study explained their paper brains were symbols of themselves as nurses and tangible representations of their patients. This symbolic nature should not be ignored as it has implications for nursing practice, job satisfaction, and nurses' understanding of their patients as discussed above. Because representation as described here is an aspect of an artifact imparted by the nurse, addressing its inclusion in an electronic brain will rely on factors beyond just presenting the right information. Nurse informaticists with clinical experience should be included on the design team. This will help to address miscommunications such as including all lab results versus only results pertinent to nurses as described above. Utilizing a true participatory design approach–directly involving practicing nurses in a collaborative design of an electronic brain–may increase a feeling of ownership and of representation of nurse identity in an electronic format (Shneiderman & Plaisant, 2010). Also, offering multiple designs of electronic brains from which nurses can choose the one that "clicks" may increase the perception of representation of nurse identity while still allowing nurses to express autonomy in their practice. Patient representation could be improved by including a visual representation like a photo or avatar for the patient, or by tying presentation of patient information through a map of patients' rooms.

Though their function goes beyond mere cognitive support, nurses' brains are cognitive artifacts, and this role cannot be ignored during design of an electronic brain. Research by Nemeth, Cook, O'Connor, and Klock (2004) examining the use of cognitive artifacts in

distributed cognition found a minimum of six traits an artifact must contain to support complex work. These include accuracy, efficiency, reliability, informativeness, clarity, and malleability (Jones & Nemeth, 2005; Nemeth et al., 2004).

The findings of Staggers et al. (2011) agree with Nemeth et al., though different wording was used. Staggers et al. found that an electronic tool designed to support handoff would need to allow precise tailoring to unit, nurse, and patient (informativeness), match nurse workflow (reliability), and highlight pertinent information determined by the nurse and patient context (efficiency). Beyond the minimum six traits of Nemeth et al., Staggers et al. added that an electronic tool would need to support encoding information. The findings of this study are consistent with the minimum six traits of Nemeth et al. However, the findings of Staggers et al. regarding paper brains' support for encoding information seemed to have less of an impact for the nurses in this study, as it was not mentioned in any interviews. The findings from this study are discussed in terms of these seven traits of cognitive artifacts with recommendations and limitations in current technology below.

5.5.1 Accuracy

An artifact is accurate if it is a current and valid representation of the system state (Jones & Nemeth, 2005; Nemeth et al., 2004). Nurses in this study updated their paper brains with handwritten notes as they obtained new information about their patients. Several hours could elapse before information is transferred to the official patient chart. Thus, data on nurses' paper brains were frequently more current than that stored in the EHR. An electronic brain should interface with the EHR so the most current information updated on the brain by the nurse would automatically sync with the patient's record. Moreover, new information added to the EHR by other providers should be pushed to an electronic brain to ensure the nurse has the most up-to-date version of orders, results, physical findings, etc.

5.5.2 Efficiency

To be efficient, an artifact must impose the least burden on its users to create and access information (Jones & Nemeth, 2005; Nemeth et al., 2004). In both the current study and previous work (Staggers et al., 2011), nurses described the ability to obtain information from their paper brains "at a glance" due to structure and the ability to emphasize information visually. Nurses also reported that writing information down on a paper brain was much more efficient than immediately entering that data to the EHR, especially when receiving information from other providers in the hallway, during rounds, or otherwise when away from a computer terminal. An electronic brain will need to allow access to information

efficiently without requiring nurses to drill down through several levels or across multiple screens. In addition, an electronic brain will need to emphasize information visually based on patient context. Finally, data entry to an electronic brain must be quick and easy for the nurse. Even with advances in smart phone and tablet computing technology, an electronic brain that can address this aspect may not yet be feasible.

5.5.3 Reliability

Reliability, according to the Jones and Nemeth (2005), refers to an artifact's availability when needed. As reported by Staggers et al. (2011), nurses in this study were also observed accessing their paper brains throughout a shift, not only during handoff. Moreover, nurses accessed their paper brains in locations where computers were not available such as hallways and the break room. At least once per shift, nurses experienced problems trying to log into the hospital's EHR. Even though the EHR was never observed to go "down" during this study, nurses reported that it was often unavailable. Their paper brains were a safeguard against the inability to access the patient record. Nurses viewed their paper brains as reliable because brains are always carried with the nurse and are immune to technical glitches. To address reliability, an electronic brain must be portable and small and light enough to be carried in a nurse's pocket. Log in times must be short, such as with a four-digit PIN or proximity chip tied to an ID card as suggested by Staggers et al. It will be difficult for an electronic brain to address the fear nurses have regarding the EHR going "down," especially with the incidence of login failures observed in this study. Until nurses believe electronic brains will reliably work when needed, the use of paper is likely to persist.

5.5.4 Informativeness

An artifact is informative if it contains information pertinent to the circumstances of interest to its user (Jones & Nemeth, 2005; Nemeth et al., 2004). Staggers et al. (2011) referred to this as "precise tailoring" of information for unit, nurse, and patient. This precise tailoring is evident in the free-form and skeleton brains in this study. Physical findings, assessment, lab results, and orders were included on these types of brains only if they pertained to the patients' conditions. Fishbone diagrams made results of CBCs and BMPs more informative for nurses, as well. Electronic brains will need to present information conditional on patient conditions and in a way that related information can be used to make critical decisions about care.

5.5.5 Clarity

Clarity in a cognitive artifact requires information to be unambiguous and free from confusion (Jones & Nemeth, 2005; Nemeth et al., 2004). Free-form and skeleton brains exhibit clarity for the nurses who own them, but not necessarily for others. This was apparent when Jane described Zoe's brain having information "just written anywhere." The Nursing Summary Report can fail at clarity when patients are so complex that orders and lab results are truncated to fit on a single page. This was seen both in this study and the results of Staggers et al. (2011). Addressing the need for clarity may raise difficulties in the development of electronic brains as space will be at a premium for a device that can fit in a pocket. Displays will need to balance the minimum amount of information needed to provide clarity with an ability to obtain more information efficiently when necessary.

5.5.6 Malleability

An artifact is malleable if it can be manipulated by its user (Jones & Nemeth, 2005; Nemeth et al., 2004). Nurses modified their brains in this study in two ways. First, nurses updated the information on their paper brains throughout a shift, adding and updating physical findings and test results, for example. Second, nurses described how they had changed the structure of their brains during their career. Malleability refers to both types of changes—within the nurse as the shift progresses, and within structure with the evolution of cognitive needs over time. Not only must electronic brains have the ability to be updated by the user during a shift as discussed with regard to accuracy and efficiency, but the overall display design must be changeable by the nurse as cognitive work evolves over time. This could be addressed with periodic evaluations of how an electronic brain is working for nurses on a unit, especially following policy changes affecting nursing work flow. Another possibility is a display design consisting of modules of related information that can placed according to the preference of individual nurses. Similar displays have been tested with physicians as part of an EHR (Senathirajah & Bakken, 2009).

In conclusion, electronic brains will need to exhibit the above seven traits of successful cognitive artifacts if they are to be adopted by nurses in a medical oncology unit. This requires digital formats to go beyond simply mimicking nurses' paper brains as electronic formats can impose difficulties that do not exist in paper formats.

5.6 Implications

Caution is necessary when hospital administration propose improving care through the standardization of handoff tools. Nurses may see such attempts as personal attacks,

affecting the culture in the hospital. This may have serious unexpected repercussions for job satisfaction and retention for nurses. Any endeavor to standardize handoff communication should include clinical nurses practicing in the hospital and an informaticist who can translate nurses' needs to a designer and result in a choice of multiple designs for each nursing context (e.g., medical, surgical, etc.). Involving practicing nurses will help to increase ownership in the process among nurses. Having multiple designs will allow nurses to express autonomy in their practice and may keep job satisfaction from decreasing.

Hospital administrators also need to be mindful of the complex nature of work in healthcare when writing policy changes. A change in workflow does not happen in a vacuum and can create unintended consequences to clinical practice. If a successful standardized handoff tool were being used, its design would need to be reevaluated periodically to insure the tool continued to meet the cognitive needs of those using it.

The results of this study illuminate an aspect of cognitive artifacts in healthcare previously neglected by informatics. As work in the field concerning cognitive artifacts such as handoff tools for all types of clinicians, and even EHRs, consideration of the "hidden lives" of these objects is advised. By simply mimicking paper-based tools on an electronic screen, functions crucial to the practice of healthcare may be lost. If these invisible functions are ignored during research, important implications may be missed.

Because paper brains play such an important role in nursing practice, they may need to have a more visible role in nursing education. While a handful of students were observed with paper brains obtained during coursework, didactic training in how and why to use a paper brain was missing from this study's participants' experiences. Expecting novice nurses to "just figure out" how to create and use a paper brain during an already overwhelming initial period on the unit may be ill-advised. Giving students the same skeleton brain may encourage discovery of differences in practice as students move through practica with different clinical foci (e.g., medical/surgical, versus ICU, versus maternity).

5.7 Limitations

No study is without its limitations. One potential limitation of this research concerns generalizability. As with any study utilizing a grounded theory approach, results may not hold beyond this medical oncology unit. While every attempt to maximize credibility was made following the recommendations of Chiovitti and Piran (2003), shadowing a different set of nurses in a different setting might have yielded different findings. For example, with the exception of Mary, all 3 of the staff nurses on the unit who used the Nursing Summary Report had less than 3 years experience as a nurse. A more experienced nurse who chose to

use the Nursing Summary Report may have provided additional insights. Further research is needed to determine if the ideas of nurse identity, patient representation, and paper brain life cycles and evolutions hold across other types of units.

A second limitation experienced in this study was the challenge of interviewing participants immediately following the shadowed shift. Both the researcher and the nurse participants experienced fatigue after an 8 to 12 hour shift. Though this time was chosen for the interview to reduce the burden on the nurse, it was difficult to elicit responses from nurses addressing more abstract questions about paper brains after nurses had been task-oriented and focused on information content for an entire shift. Though saturation was reached in this study, the timing of interviews may have limited the ability of both the researcher and the nurse participants to fully explore the possible cultural implications of paper brain production and use. Future studies could use data collection methods such as focus groups or reflective journaling to alleviate this problem.

5.8 Future Research

The results from this dissertation research illuminate areas for future studies. First, further study is needed explore the different types of brains. Additional exploration of what makes a paper brain "click" with a particular nurse would be a good place to start. Is preference of a specific type of brain related to nurse characteristics like length of experience, age, or gender? Moreover, do nurses who choose a particular brain type have better cognitive outcomes as a group? A mixed-methods study could be employed to address both of these questions. Interviews or focus groups could be used to address how brains "click" and with whom, and a controlled experiment in a simulated setting could be used to examine cognitive outcomes (e.g., recall of information). In such an experiment, nurses could be randomized to receive a brain that either corresponds or does not correspond to their preferred format.

Second, further work is needed to explore the relationship between paper brains and nurse identity. One potential study could examine if nurses in other settings view their paper brains as representing their identity as nurses. Though the results of Staggers et al. (2012, 2011) hint that nurses in other acute care units may speak about their paper brains in a similar way, the views of nurses from emergency departments, psychiatric units, and rehabilitation units have yet to be studied. Nurses in settings outside the hospital such as nursing homes could be a potential population, as well. Additionally, the relationship between paper brains and nurse identity should be explored with respect to nurse characteristics. For example, does this relationship vary with nurse age, experience, or

gender? Furthermore, the relationship between paper cognitive artifacts and identity should also be examined in other professions. Do other providers view their cognitive artifacts as a representation of themselves as an individual or professional?

A third area of future study is the centrality of paper brains for holding the story of the patient in other contexts. Studies in psychiatric units or rehabilitation units are needed to explore if the story of the patient and paper brains are related for nurses caring for patients with similarly long disease trajectories. And, studies in units with shorter stays, such as surgical units or an emergency department, are needed to determine if the story of the patient is given as prominent a place in paper brains of nurses caring for patients with shorter disease trajectories.

Unit type and patients' disease trajectories may also affect the life cycle of paper brains. For example, do nurses working in units with a shorter patient disease trajectory store their brains for later use? Is the length of time brains are stored related to the patients' lengths of stay or the likelihood of readmission?

A fourth area of future work is the further examination of the concept of "good enough" in the evolution of paper brains. The limits of what "good enough" actually is needs to be explored. In other words, at what point does a nurse stop needing to make a change in a brain in order for it to continue to be useful? In addition, more work is needed to examine how quickly a brain becomes solidified in this state. Research in these area will lead to better designs for future handoff tools by illuminating boundaries of necessary malleability of a design, and the subset of information that is consistent across all versions of a brain for a particular nurse.

5.9 Conclusion

This dissertation research developed a deep understanding of nurses' paper brains in a medical oncology unit. Beyond providing cognitive support as a cognitive artifact, paper brains are a symbol of nurse identity and individuality, brains represent the patient by holding the "story of the patient," and experience a life cycle during each shift and evolve over the course of a nurse's career. These additional functions of paper brains and current limits in technology limit the potential success of standardized electronic nursing handoff tools. Study findings have implications for hospital administrators, the field of informatics both in practice and research, and education of future nurses. Further research is necessary to determine if these results will apply outside the medical oncology unit.

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